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A Revision of the Mite Family Bdellidae in North and Central America (Acarina, Prostigmata)

BY

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ABSTRACT. This study, although primarily a monographic revision, includes data on the bionomics, morphology, and intraspecific variation of the bdellids. Eleven genera are recognized, including a new genus *Octobdellodes;* four genera or subgenera are synonymized, these are: *Cacnobdella* Oudemans, 1937 (= *Bdella*), *Troglobdella* Oudemans, 1937 (= *Cyta*), *Hoplomolgus* Berlese, 1923 (= *Neomolgus*), and *Hoploscirus* Thor, 1937 (= *Bdellodes*).

Thirty-two species are included in this paper, of which sixteen are new. Four species are moved to other genera, and thirteen species, for which type materials are available, are synonymized. For other synonymies, Thor (1931) is recognized.

The sixteen new species described are: *Bdella longistriata, B. tropica, Bdellodes bisctosa, Cyta spuria, Neomolgus mutabilis, Octobdellodes hurdi, O. infrequens, Odontoscirus iota, O. alphinus, Thoribdella communis, T. insolita, T. simplex, T. spinosa, T. communis, Spinibdella bifurcata, S. ornata.*

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INTRODUCTION

The purpose of this study has been to develop a solid basis for the systematics of the family Bdellidae. Inadequate descriptions, loss of types, and conflicting impressions of the type genus *Bdella* often make it wholly impossible to determine which of the previously proposed species are valid.

Of the twenty-five hundred specimens examined, approximately twenty-one hundred were from Central and North America, two hundred from Iceland, one hundred from Australia, one hundred from Europe, and less than five from each of the continents South America, Asia, and Africa. Although over one hundred species and eighteen varieties have been described in the literature, only twenty named species were discovered, of which, sixteen occurred in Central and North America. Thor (1931) synonymized many species with those that appeared to him to be valid. Thor's synonymies will not be questioned in the present investigation, which, due to the lack of abundant European material, is necessarily restricted in scope.

To clarify my position in the taxonomy and systematics of this group, detailed descriptions and illustrations have been introduced for the known species of Central and North America, which number sixteen named and sixteen new species.

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COLLECTION OF MATERIAL

It is desirable to collect and preserve these mites in such a way as to avoid contamination with fine particles of dirt and sand. Both of these substances readily adhere to the integument and, even with drastic clearing methods, so much accumulation may remain on the specimen that even generic determinations are difficult.

Berlese funnels efficiently extract bdellids from litter, soil, nests, and compact plants, such as mosses and foliose lichens. Water is superior to alcohol in the Berlese collecting vial. The high surface tension of water, as compared to alcohol, will support many of the mites on the surface while permitting soil particles to sink. With a small brush or spatula, the mites can be transferred to a preservative with a minimum of extraneous matter.

To collect from moss, lichens, and other miscellaneous epiphytes *en situ*, one can beat the material over a white enamel pan and remove the dislodged mites from the pan with a small brush. Similarly, individual mites can be removed from rocks, boards and other relatively large and smooth surfaces.

Habitat specificity has not been demonstrated in the Bdellidae, although this may be due to a lack of data that would mask the character of the true situation in this regard.

PREPARATION OF MATERIAL

Two satisfactory media for mounting bdellids, which are soft-bodied mites, have been used. These are polyvinyl alcohol with lactic acid and phenol added (PVA-L-P) and Hoyer's modification of Berlese's mounting medium (see Beer, 1954, for formulations). Comparing these two media, each has certain advantages and disadvantages. PVA-L-P has less clearing action and it is less difficult to prepare specimens in which appendages are in the same horizontal plane, but to remount from this medium is an extremely hazardous undertaking with specimens having a soft integument. Hoyer's clearing properties are excellent for smaller uncleared bdellids, causing little distortion in striations, shape or size. Although

slightly more difficult to use than PVA-L-P, the ease with which specimens can be remounted without the loss of or damage to parts is an advantage that cannot be over-emphasized.

Characters necessary for specific determinations are located on both the dorsal and ventral surfaces of the body. For this reason, large and opaque specimens must have their body contents removed or thoroughly cleared before mounting. Other specific characters are found on the surfaces of the legs and palps. For easy study, it is therefore desirable to have these appendages similarly oriented and extended in the same horizontal plane. Heating of specimens in lacto-phenol at 200° to 250° F. for a short time will soften the leg muscles sufficiently to allow easy manipulation of these appendages and further heating in lacto-phenol slightly under the boiling point (up to 400° F. after moderate evaporation) will dissolve the body contents. The time required for the latter process is variable, depending on the size of the specimen and the type of preservative. Potassium hydroxide, although used as a clearing agent in many groups, is not a satisfactory reagent for bdellids as its drastic action causes a considerable loss of diagnostic setae.

Specimens used for the study of musculature were prepared by a different process. Bdellids, previously preserved in ninety-five per cent alcohol, were cleared in beechwood creosote for five to ten minutes, then transferred directly to thin balsam. The palps and legs were removed from the body with small needles and placed in the mounting medium. A cover slip, first immersed in xylene, was gently pressed against the specimen until the appendages were in the same horizontal plane.

GEOGRAPHICAL DISTRIBUTION

Mites of the family Bdellidae have been collected from all major land masses of the world and from many insular groups. When distribution records are more complete, many species will probably be found to be cosmopolitan in distribution. Many of the species found in the Western Hemisphere are also found in other parts of the world. One species is known to occur in North America from Mexico to Alaska, as well as in Iceland and Europe. One species has been collected in China, Australia, Hawaii, and North America. Another species is circumpolar in distribution.

BIONOMICS

Bdellids are active, fast-running mites, predaceous on small arthropods and arthropod eggs. They seem to occur in almost every terrestrial habitat where food material is available. Three investigations on the biology of these mites have been reported. Womersley (1933a) and Currie (1933) studied one species as a possible biological control agent for the clover springtail or lucerne flea (*Sminthurus viridis* L.) and Snetsinger (1956) studied the biology of *Spinibdella depressa* (Ewing).

Species observed in temperate regions apparently have broad temperature and humidity tolerances. Although specimens are most frequently collected in moist, cool habitats, this may be a consequence of the availability of food animals. Many individuals have been collected from dry, exposed surfaces, and Bornemissza *(in litt.)* has evidence indicating that a *Cyta* species may be restricted to the desert regions in Australia. On the other hand, Snetsinger (1956) could obtain complete life histories only at ninety per cent relative humidity between sixty and seventy degrees Fahrenheit.

Bdellids in temperate climates overwinter in all stages of development. In Kansas, the author has collected all the active stages of local *Cyta* and *Bdella* species from leaf litter as early as February 22, and although the deutonymphal and tritonymphal stages were the most prevalent, the larvae, protonymphs, and adults were also present. Snetsinger (1956) observed that in Illinois the egg stage is the most abundant overwintering form of *Spinibdella depressa,* but all stages except the larval stage were found hibernating under tree bark.

These mites have the life history stages found in many trombidiform mites, that is, egg, deutovum, larva, three nymphal stages, and adult. Each active immature stage ends in a period of quiesence, following which the old integument is shed. Currie (1933) reported that one nymph of *Biscirus lapidarius* consumed eighteen immature clover springtails on each of three successive days, and Snetsinger (1956) reported that immatures of *Spinibdella depressa* require three or more tetranychid mites to complete each developmental stage. The latter author also found that the length of time necessary for development is partially dependent on temperature, lengthening as the temperature decreases. Development from larva to adult at ninety percent relative humidity required twenty-one to thirty days at sixty degrees Fahrenheit, but only fourteen to twenty-one days at seventy degrees.

Oviposition preferenda have not been reported; however, there is a tendency for the females to lay eggs in protected areas. In stender dishes coated with a plaster-of-paris and charcoal mixture (Lipovsky, 1953) and marked with a deep line to simulate a crack, the author observed the sites of egg deposition of four females. Sixteen spiny elliptical eggs, laid singly at the rate of one egg each one and one-half days, were deposited in the prepared crevice at the bottom of the dish, while only one egg was laid in an exposed area near the wall of the dish. In the field, Snetsinger (1956) found that large numbers of eggs were deposited during the autumn months under the basal bark of trees, probably a result of females aggregating in protected spots at the onset of cold weather.

Parthenogenesis has not been discovered in the Bdellidae. Although the forty-five specimens of *Bdella trop'ca*, sp. nov. and one hundred and forty-six specimens of *Spinibdella cronini* examined in this study were all females, this cannot be construed as proof of parthenogenetic development. In all species for which large numbers of specimens were available, there were usually many more females than males. For example, there were one hundred and fifty-six females and forty males of *Bdella longicornis* and ninety-two females and only four males of *Bdella muscorum*. The sexes were approximately equal in number only in *Bdellodes longirostris*, of which forty-eight females and forty-four males were examined. Occasionally in small collections of two to ten specimens of the three latter species, all or most of the individuals were males. Plausible explanations for the scarcity of males, especially for *B. tropica* and S. *cronini*, could be that the sex ratio is extremely unequal; that the males have different habitat preferences; or that they have different peaks of seasonal abundance.

Personal observations on feeding habits were made by the use of covered stender dishes with collembola as the food source. Bdellids, when placed with collembola, move slowly until contact is made with the distal setae of the palpi. If the mite is startled, it will run rapidly backwards. If not startled, the mite will lunge at the prey, impaling it on the tips of the mouth parts. The chelicerae are rapidly and alternately extended and retracted at various angles into the body of the prey, while the chelae are opened and closed, thus macerating the tissues. If disturbed while feeding, the bdellid elevates the tip of the gnathosoma with the mouth parts still inserted in the prey, and in this fashion the mite may move away from distracting influences. When feeding is completed, the mite either goes to a secluded spot or again moves slowly about the dish.

MORPHOLOGY

General

The general body configuration of the bdellids has been known for many years. Geoffroy's (1762) drawing of *Bdella longicornis*, even with its inaccuracies, can easily be recognized as belonging to this family. The knowledge of the external morphology has increased with better optical equipment, culminating with Grandjean's (1938) investigation. The internal morphology is known only from Michael's (1896) study of the internal anatomy of *Neomolgus littoralis* (= *Bdella basteri* Johnston, 1836).

The body is divided into three distinct regions, the gnathosoma, propodosoma, and hysterosoma. The anterior gnathosoma consists of two elongate, chelate chelicerae (mandibles of authors), a ventral hypostome (rostrum of authors), and two geniculate palpi. Collectively the chelicerae and hypostome form a conelike structure projecting from between the palpal bases. The propodosoma bears the two anterior pairs of legs, eyes, and pseudostigmatic organs, this region being delimited dorsoposteriorly by a conspicuous constriction. The hysterosoma bears the posterior legs, anus, and genitalia.

Segmentation of Appendages

In order to determine the possible homologies between the legs and the palpi, it is necessary to establish basic relationships in the more primitive of the two types of appendages, the legs. Bdellid larvae have seven-segmented legs (including the pretarsus), lacking the division between the basifemur and the telofemur. The division of the femur is barely perceptible in the anterior three pairs of legs in the protonymph; but each succeeding instar exhibits a progressively more-distinct femoral division in all legs. Camin has prepared diagrammatic illustrations of the musculature of the legs and palpi (figs. 3-5). According to Camin's forthcoming theory (in manuscript), he believes that, primitively, each primary segment of the leg had two flexor muscles which insert on the succeeding segment. In bdellids, the three distal segments have undergone considerable change and may not represent the primitive genu, tibia, and tarsus, but for convenience they will be denoted by the standard terminology in this paper. The primitive condition is best demonstrated in the femur which has two flexor muscles (fig. 3, *a, a*) inserted at the base of the genu. An advanced feature, the ventral flexor muscle of the telofemur may be a branch of the proxi-

mal flexor of the genu, the insertion of which has migrated. The undivided femur in the larva and the lack of muscles inserting on the telofemur in all developmental stages suggest that the telofemur is not a primary segment but a secondary subdivision of the femur allowing additional flexibility of the legs.

Previous workers have referred to the three distal segments of the palpus as the genu, tibia, and tarsus. Although the musculature of the palpus is greatly reduced, it is possible to homologize the palpal segments with the segments of the leg, thus demonstrating that these segments represent the telofemur, genu, and fused tibiotarsus. The femur, partially divided into basi- and telofemur, has two long flexor muscles (fig. 5, *a*, *a*) homologous to flexor muscles in the legs; the small extensor muscle (fig. 5, *f*) has no homologue in the legs. Two muscles inserting at the base of the distal segment, with origins in the penultimate segment and telofemur, can be homologized with the flexors of the tibiae of the legs. The penultimate segment of the palpus can therefore be homologized with the genu of the leg. The distal palpal segment, lacking muscles and pretarsal elements, represents the remaining segments, the tibia, tarsus, and pretarsus. In the Cunaxidae, the musculature of the palpus (fig. 6) is similar to that in the bdellids, but there is an incomplete fusion of the tibia and tarsus.

Setae

Two general types of setae are abundant: thick-walled (tactile) setae and thin-walled (chemosensory) setae. The tactile setae ("Eigentlichen Haare" of Vitzthum, "Poils proprement dits" of Grandjean) are inserted in alveoli, are movable, tapering, nude or plumose, and have extremely small lumina. The chemosensory setae ("solenidions" of Grandjean), for convenience termed sensory setae, are inserted in small pits or depressions lacking alveoli; they are fixed, nude or minutely pilose, and have large lumina. Commonly, the form of the thin-walled setae is slender and tapering (attenuate) (fig. 189), or thick and broadly rounded distally (fig. 188). The tips of both forms curve away from the body. In bdellids, the sensory setae are not striated as in many other groups of prostigmatic mites. Sensory setae are restricted to the four distal segments of the legs except for one on the palpal tibiotarsus.

The long apical setae of the palpal tibiotarsus, which are tactile in function, have two types of insertions. In *Cyta* and a few species of *Bdella* and *Spinibdella*, the setae originate deep within the seg-

ment; in the other genera studied, the apical setae are slightly enlarged at their bases and inserted in superficial sockets. Commonly in the Odontoscirinae, the edges of the apical sockets are heavily sclerotized and form distinct rims.

The four sensilla, although of variable lengths and diameters, are long and tapering (except *Thoribdella*) and each is inserted in a pseudostigmatic organ. In the genus *Thoribdella*, the posterior sensilla vary from short thin setae to short thickened rods which are divided in the middle into three connecting arms (fig. 150).

A third type of seta is short and peglike and has a variety of shapes and forms (figs. 190-193). Solid pegs, possibly blunt spines, are found on the dorsolateral rims of coxae I and II (fig. 2, *f*) and on the dorsolateral regions of the hypostomal bases in close proximity to the cheliceral bases ("L'épine latérocoxale du palpe" of Grandjean). The positions of these three pairs of setae suggest that they function as proprioceptors. Other pegs, maximally one on each of the two distal segments of legs I and II, are inserted in pits, lack alveoli, and may represent highly modified chemosensory setae.

Chaetotaxy of the Legs

The chaetotaxy of the legs provides important taxonomic characters. The majority of the leg setae are tactile, and sensory setae and pegs occur only on the dorsal surfaces. Tactile setae are arranged on the legs as follows: two or more rows of ventral setae that tend to be plumose on the tarsi; one row each on the anterior and posterior (lateral) surfaces, and one to three unpaired setae on the dorsal surface of each segment except the coxa.

The majority of the sensory setae occur on legs I and II, with leg I having the greater number. Tarsus I has two, occasionally three, broadly rounded sensory setae (fig. 188), two or more attenuate sensory setae (fig. 189), and usually one peg (figs. 190-193). Tarsus II usually has the same number of blunt sensory setae and pegs, but fewer attenuate sensory setae than tarsus I. The proximal halves of tibiae I and II have only attenuate sensory setae, but the distal portions may have any combination of the various types of specialized setae. The tibiae and tarsi of legs III and IV have only the attenuate type of sensory setae.

Duplex setae similar to those found in the Tetranychidae (Prichard and Baker, 1955) and/or attenuate sensory setae are inserted on the genua. When duplex setae are present, they occur on the anterior three genua, but may be wanting on genu IV. The inser-

tions of the micro- and macrosetae that comprise a duplex seta may be confluent, separate and approximate, or separate and distant (figs. 194-197).

The number of tactile setae may vary considerably within a species, as is the case with the attenuate sensory setae on the genua and proximal halves of tibiae I and II. The other types of sensory setae are usually constant in number, but may vary in position (see p. 365).

Trichoboths (long tactile setae) are inserted in deep, heavily sclerotized sockets (fig. 184) and are similar in structure to the dorsal sensilla. The maximum number of trichoboths is five pairs, which are inserted on tibiae I, II, and IV and tarsi III and IV. The subfamilies are characterized, in part, by the number of trichoboths present in the adult stage. The Odontoscirinae have five pairs arranged as above; the Spinibdellinae and Bdellinae have four pairs, lacking the trichoboth on tibia II (*Bdella mexicana* also lacks the trichoboth on tarsus IV); and the Cytinae have less than four pairs. In the latter subfamily, trichoboths are inserted on tibiae I and IV and tarsus III except *Cyta latirostris* which has only one trichoboth inserted on tibia IV. In species with less than five pairs of trichoboths there is a large tactile seta in the position normally occupied by a trichoboth when compared with the Odontoscirinae.

The larvae of all species studied (except *Cyta latirostris*) have one trichoboth which is inserted on tarsus III; the protonymphs have the same number of trichoboths as the adult on the anterior three pairs of legs, but leg IV has none; succeeding instars have the adult number on all legs. *C. latirostris* is an exception, having one trichoboth inserted on tibia IV in the tritonymphal and adult stages, the other instars lack trichoboths.

The extremities of all the tarsi are abruptly narrowed subapically where the dorsal tarsal surfaces bend sharply downward to the pretarsus. On each of the oblique surfaces thus formed are three pairs of setae which constitute the dorsoterminals. The proximal pair of dorsoterminals (*dt 1*) are long and curve obliquely from the claws (leg IV may have only one seta in this position). The second pair (*dt 2*) is inserted midway between *dt 1* and the pretarsus, and the distal pair (*dt 3*) flanks the pretarsus. The two distal pairs (*dt 2, 3*) extend to the bases of claws and are present in all known species except *Biscirus silvaticus* which lacks one of the middle pairs of setae. The dorsoterminals may be thick-walled (termed solid) or thin-walled (termed hollow) and may be nude to coarsely branched

(figs. 179-183, 185-187). Although different forms may occur on different legs, the structure of the dorsoterminals is usually constant within a species. Generally, thin-walled setae on the anterior legs are replaced by thick-walled setae on the posterior legs.

The short pretarsus, indistinctly divided on its dorsal surface into three pseudosegments, arises between *dt* 3. The distally inserted claws may have one, two, or no small dorsal ridges bearing laterally directed rays (fig. 70). These rays may be long and few in number or minute and numerous. In the latter case, the small rays are designated as the minute rays. Only the size of the claws and the presence or absence of lateral and/or minute rays were found to be of taxonomic value.

Gnathosoma

The gnathosoma, consisting of the elongate chelicerae, hypostome and palpi, is one of the most characteristic features of the Bdellidae. The geniculate palpus has six segments: coxa, trochanter, basifemur, telofemur, genu and tibiotarsus, the latter bearing apically one or two long tactile setae. The coxa is fused with the base of the hypostome, and thus is indistinguishable as a separate segment. The trochanter is small and devoid of setae. The femur is incompletely divided into a long proximal basifemur and a short distal telofemur. The basifemur bears a variable number of setae, but the telofemur has only one seta that is always inserted on the dorsal surface. The genu may be as long or longer than the telofemur and bears two to seven setae. The terminal, fused tibiotarsus varies greatly in length and shape. Typically, the tibiotarsus is approximately the length of the genu plus the telofemur, is expanded distally, and obliquely truncated at the apex; or it may be more than twice as long as the genu plus the telofemur, cylindrical, and apically rounded. Unfortunately, there are many intergrades between these two readily recognized conditions, thereby making size and shape of the palpal tibiotarsus a highly subjective character in many instances.

The dorsal and ventral apical setae resemble the trichoboths of the legs and the dorsal sensilla. In the Odontoscirinae, the end setae are approximately equal in length and shorter than the cylindrical tibiotarsus. In *Monotrichobdella,* there is a single apical seta. In the remaining genera, the end setae are subequal and usually much longer than the tibiotarsus.

In life, the geniculate palpi are flexed at the two distal articulations and are carried extending forward and bowed upward. In slide preparations, especially with cleared specimens, the medial or

lateral aspects are most frequently encountered. Two useful points for determining orientation of the palpus are the relative positions of the dorsal and ventral end setae and the position of the single dorsal seta of the telofemur.

The chelicerae are elongated and bear movable chelae. The number and position of setae, the shape of the chelicerae, and the form of the chelae are sufficient to distinguish many genera.

The majority of the genera have normal chelicerae which are approximately three to five times as wide at their thickest portion as at their thinnest, and have chelae with small sickle-shaped movable digits and small straight fixed digits (figs. 7-8). The inflated chelicerae of a few species of *Odontoscirus* and *Bdella* (figs. 13, 16) are more than five times wider at the base than at their narrowest parts. In *Odontoscirus* the inner surface of the movable digit is straight if the teeth are disregarded (figs. 9, 16, 17). A third cheliceral shape occurs in the Spinibdellinae (figs. 32-35) which has a narrow form with almost parallel sides and needlelike chelae (fig. 10). The genus *Cyta* is unique in having large, thickened chelicerae (figs. 30-31) tipped with massive chelae (fig. 11). One or more teeth may be present on the inner surfaces of the fixed digits.

Two setae are inserted on the dorsal or dorsolateral surfaces of the chelicerae in most genera. *Cyta* has two setae on each chelicera, but one is inserted at the base of the fixed digit (fig. 11); *Neomolgus* has more than two setae; and *Bdellodes longirostris* and one undescribed species of *Thoribdella* from Australia have only one seta on each chelicera.

Viewed from the ventral aspect, the gnathosoma has three distinct regions (fig. 2): a transversely striated, rectangular base bearing the palpi at the anterolateral angles; a long, gently tapering buccal cone; and two small, terminally fringed lateral lips which are separated from the buccal cone by a weak suture. The rectangular gnathosomal base consists of the palpal coxae fused with a basal portion of the hypostome, and the buccal cone and the lateral lips represent the major region of the hypostome.

The setae inserted on the gnathosoma can be best characterized by their positions. The ventral hypostomals (*vh* series) are on the ventrolateral surfaces of the buccal cone and the anterior margin of the hypostomal base. In adults, either two, six, or seven pairs of these setae are present. Two pairs of small adornal setae inserted on the lateral lips are present in all the developmental stages. Finally, one pair of setae may be present on the dorsal surface of

the hypostome; when present, these setae are covered by the bases of the chelicerae ("les poils prémandibulaires" of Grandjean). When characteristic for a species, these dorsal hypostomal setae occur in all the stages of development.

In genera with six or seven pairs of ventral hypostomal setae, the immature stages may be identified by the number of setae present. The larvae have two pairs; the deutonymphs, four pairs; and the tritonymphs have five pairs. The Cytinae and Spinibdellinae have two pairs of ventral hypostomal setae in all stages.

The dorsum of the propodosoma has a thicker integument than the remainder of the idiosoma. A uniform thickening on the inner surface has developed which is approximately rectangular to reniform in shape, and encompasses the four pseudostigmatic organs ("shield" of authors). This thickening of the integument attains greatest development in the Odontoscirinae.

Internal ridges or apodemes connecting the pseudostigmatic organs laterally and sometimes anteriorly have developed secondarily in a few species. In their simplest form, the lateral apodemes are narrow with parallel margins (fig. 140). More complex forms, as in *Bdella longicornis*, have smaller thickenings mesal or lateral to the prominent lateral apodemes which form an interlacing network of supporting structures (figs. 133-135).

Two pairs of sensilla are inserted in the pseudostigmatic organs. In all the genera except *Thoribdella*, the pseudostigmata are cup-like sockets lined with concentric rings of small ridges and often are heavily sclerotized. In *Thoribdella*, the posterior pseudostigmata (figs. 142-149) are deep, goblet-shaped cavities of thin integument, lined with finely divided ridges which are perpendicular to the insertions of the sensilla.

A pair of median propodosomal setae (fig. 1) is always present between the posterior sensilla. In structure, these setae resemble the dorsal hysterosomal setae. Another pair of setae, the lateral propodosomals, may or may not be present. If present, they are inserted lateral to a line connecting the lateral sensilla. In structure, the lateral propodosomals are usually simpler than the median propodosomal setae.

The integumental striae between the dorsal sensilla form distinctive shield patterns. A particular pattern may be unique to a species, or as in the Odontoscirinae, a pattern may be common to many species. Each striation is a sharp ridgelike external thickening of the integument with small breaks along the crest. In micro-

scopic examination, the breaks cause the striae to appear finely broken (fig. 133), coarsely broken (fig. 156), or sparsely broken (fig. 136).

The eyes are lateral or posterolateral to the posterior sensilla. Two pairs are usually present, and the eyes of each pair may be approximate to distant. One species, *Spinibdella depessa*, has the posterior eyes wanting, but their former positions are indicated by teardrop patterns of the striae. In addition to the lateral eyes, *Cyta* has a fifth eye between the anterior sensilla (fig. 165). A fifth eye or protuberance in a similar position was reported by Baker and Balock (1944) in their original description of *Monotrichobdella maxosburni*, but this could not be distinguished in the remounted type specimen.

The podocephalic canal (Grandjean, 1938) could not be adequately examined in specimens mounted in Hoyer's or PVA-L-P. Grandjean describes this canal as being an external groove in the integument or an internal tube which originates on each side of the dorsoposterior surface of the buccal cone, follows the contours of the lateral body wall, and terminates above coxa I. Three tubular glands of unknown function open into the canal: one near the laterocoxal spine of the palpus, one at the junction of the idiosoma and the gnathosomal base, and one close to the termination of the canal above coxa I.

Dorsal Hysterosoma

The dorsum of the hysterosoma has five transverse rows of setae (fig. 1). Using the nomenclature of Oudemans (*fide* Vitzthum, 1943), these setae are:

1. internal and external humerals
2. internal dorsals
3. internal lumbrals
4. internal and external sacrals
5. internal and external clunals

The sacrals and clunals are arranged in gently to strongly curved, transverse rows, or in extreme modifications, in a subrectangular arrangement. In a few species, the external clunals are wanting. The hysterosomal setae are nude to plumose and are usually constant in form within a species. In a few species the form varies in populations from different geographical areas. The longitudinal intervals between the internal humerals and the internal dorsals, the first interspaces, are used as a relative measurement of the lengths of the internal humerals.

Anal Region

The posterior anal cleft is surrounded by striae (border striae) which either parallel the entire length of the cleft or are parallel to approximately the center of the cleft, then bend sharply laterad. The setae of the anal region (figs. 1, 2) differ from the dorsal hysterosomals in being shorter, thinner, and usually nude. One or more pairs of setae situated in the region of the parallel striations are considered to be the anal setae, or anals. One pair of setae near the dorsal termination of the anal cleft is termed the posterior paranals, or postanals. Other setae, lateral to the anals are the paranals.

Genital Region

Two longitudinally striated genital plates or flaps are situated on the venter of the hysterosoma between the anal cleft and coxae IV. Each plate bears a regular or irregular row of genital setae which may vary slightly in position and number within a species. The area surrounding the genital plates has bilaterally arranged pairs of paragenital setae (figs. 2 *g*, 178 *b*). In the Cytinae, there is an unpaired median seta immediately anterior to the genital plates (fig. 178 *c*). Species of *Spinibdella* may have unpaired setae, but they occur between coxae IV.

When the genitalia are in repose, a chamber or vestibule is formed above the genital plates, the walls of which are contiguous with the mesal edges of the plates. Three subequal genital discs, each with a small spine of unknown function immediately caudad, are on the lateral walls of the vestibule.

Because of the method of preparation, only sclerotized portions of the genitalia remained for examination. The ovipositor is a large membraneous tube which can be telescoped into the body or wholly extruded. When in the latter position, the genital discs are carried outside the body and are at the base of the ovipositor. Slightly distal to the mid-length as many as four pairs of postmedial setae may be present, and surrounding the tip of the ovipositor there are six to ten pairs of subapical setae. A transverse cleft bisects the apex, and two small, heavily sclerotized structures, probably glands, are internal to the angles of this cleft.

The male genitalia are more complicated. In the pair of large sclerotized plates, the amphioid sclerites (Michael, 1896), each has the lateral edge bent dorsad to form a dorsal arm. Simple to highly modified setae form an irregular series along the periphery of each

amphioid sclerite (figs. 169-177). The penis is a thin muscular organ surrounded by a loose membranous sheath (Michael, 1896). During copulation, the amphioid sclerites are everted, thus placing the dorsal setae in a ventral position in contact with the exterior. Evidently, the penis is connected to the dorsal arms of the sclerites and carried outward with the eversion of these sclerites.

Specific differences in the male and female genitalia exist, but only the males of *Spinibdella* and *Cyta* have differences striking enough to warrant their use as a taxonomic character at this time. Although males were present for only three species of *Spinibdella,* the bizarre modifications of the amphioid setae appear to be specific and stable characters. The setae of the three *Cyta* species lack unique shapes, but have different arrangements and lengths. In other genera, the setae lining the amphioid sclerites are similar in structure, the slight differences in length and position could not be evaluated. Differences in the female genitalia are slight and can be detected only if the ovipositor is almost wholly extruded, a condition of rare occurrence.

Genital tracheae, present in the Spinibdellinae and Cytinae, open into the genital vestibule in front of the anterior pair of genital discs (fig. 178 *d*). These paired structures are round and have spiral thickenings which resemble the taenidia of insect tracheae (except *Trachymolgus,* see below). The genital tracheae of the Cytinae each have a single dichotomy near the origin, one branch leading to the anterior tracheal opening near the cheliceral base, the other branch ending above coxa I. In the Spinibdellinae, the tracheae lack dichotomies; a single branch on each side of the body ends above coxa II. Relatively large, flat platytracheae, which are expanded at their distal terminations, originate in the anterior region of the genital vestibule and end above coxae II in *Trachymolgus* (Grandjean, 1938).

Immature stages can be distinguished by the number of genital setae and genital discs. Protonymphs have one pair of genital discs, deutonymphs have two pairs, and tritonymphs and adults have three pairs. Genital setae also increase in number in the progressive instars; protonymphs have one pair (*Biscirus silvaticus* has none), deutonymphs have two pairs (*Cyta latirostris* has one pair), tritonymphs have four to eight pairs, and the adults possess more genital setae than their respective tritonymphs.

SYSTEMATIC RELATIONSHIPS

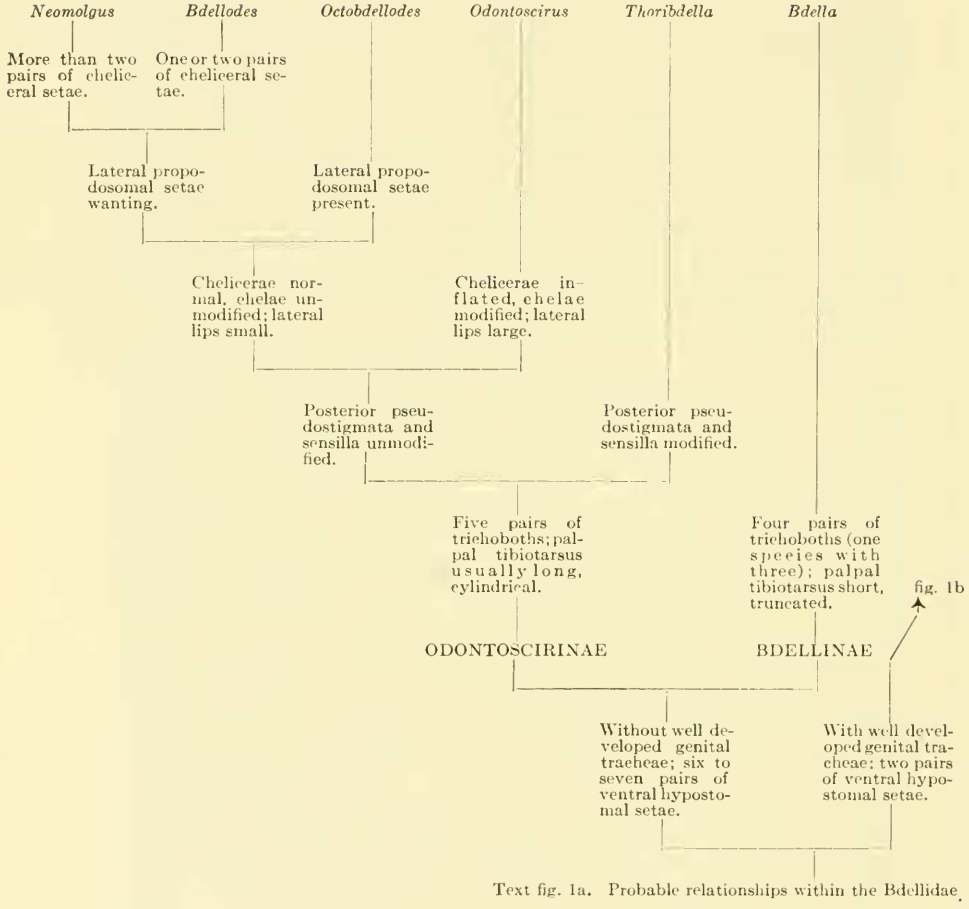
Except for occasional oversights, there has been little question among acarologists as to what constitutes the group commonly known as the "snout mites." These mites have been identified as being soft-bodied, predaceous mites with an elongated, conelike gnathosoma, chelate chelicerae, and long, modified palpi. In 1902, Thor divided the Bdellidae, erecting a new family, the Cunaxidae, for "snout mites" with palpi modified for grasping prey and retaining the name Bdellidae for the remainder of the group.

Until recently, bdellids could be easily differentiated from cunaxids by the presence of one or two long, tactile setae at the apices of the palpi. Although this character has been shown to occur in at least one species of Cunaxidae (Atyeo, 1958), the families Bdellidae and Cunaxidae still seem separable and the present paper deals only with the former.

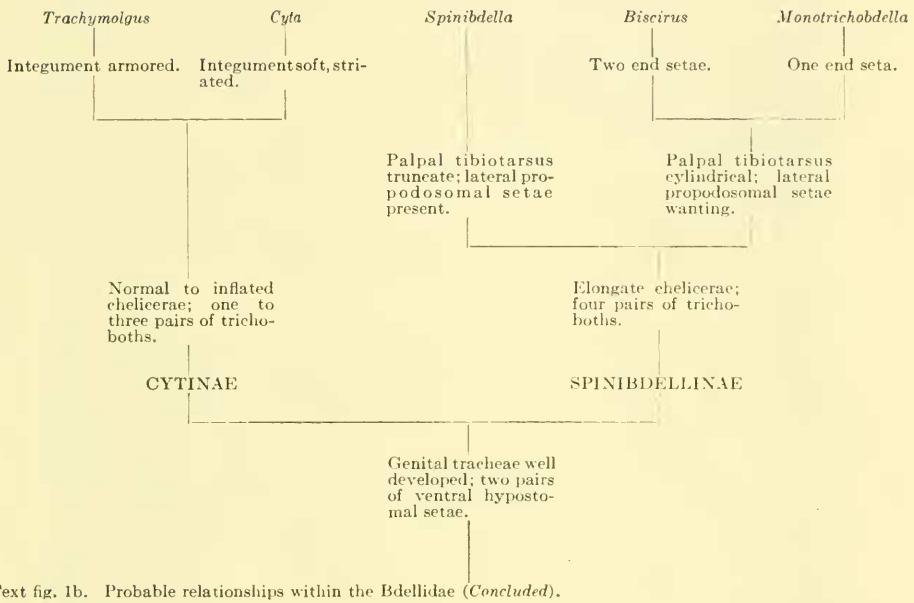
Bdellids are characterized as having well developed, chelate chelicerae; padlike, rayed empodia; five-segmented, tactile palpi; two, four, or five eyes; finely striated integument (except *Trachymolgus*); three pairs of genital discs; and usually more than one pair of trichoboths. Cunaxids have chelicerae with the fixed digit wanting; empodia reduced to a few rays; three to five-segmented palpi usually modified for grasping prey and usually armed with strong spines or apophyses; eyes present or wanting; integuments usually with nonstriated plates; two pairs of genital discs; and one pair of trichoboths.

In attempting to determine the probable relationships within the Bdellidae, the genital tracheae and the ventral hypostomal setae seem especially important. Two major groups can be recognized, one with well developed genital tracheae and two pairs of ventral hypostomal setae, the other without well developed genital tracheae and with six to seven pairs of ventral hypostomals. Within these two groups Grandjean (1938) placed genera showing strong affinities into four subfamilies (see key, p. 371) which appear to be natural groups.

Except for *Odontoscirus* and the species of *Bdella* having inflated cheliceral bases, the shape of the chelicerae, the position of the cheliceral setae (except *Neomolgus*), and the unmodified chelae are identical in both the groups lacking genital tracheae, the Odontoscirinae and the Bdellinae (text fig. 1a). In the subfamilies with genital tracheae, the chelicerae are either elongated and have



Text fig. 1a. Probable relationships within the Bdellidae.



Text fig. 1b. Probable relationships within the Bdellidae (*Concluded*).

needlelike chelae (Spinibdellinae) or are greatly thickened with massive chelae (Cytinae, except possibly *Trachymolgus*), and the anterior cheliceral seta is inserted on the distal fourth of the chelicera.

Only a few characters are available for generic separation (text figs. 1a, 1b). Although genera separated on these characters appear to form natural groups, one difference does occur that cannot be evaluated. In the Odontoscirinae, only three species have lateral propodosomal setae; *Octobdellodes* gen. nov. has been erected to include two of these species. The third undoubtedly belongs to *Thoribdella*, as it has highly modified posterior sensilla. Except for this single species of *Thoribdella*, the presence or absence of the lateral propodosomal setae is a stable generic character, therefore, the exact significance of one anomalous species cannot be ascertained.

Internal apodemes on the dorsal propodosoma occur in species of the Bdellinae and the Cytinae. The large rectangular to reniform-shaped thickening of the integument varies according to the species in all groups, but it is best developed in some members of the Odontoscirinae. Cuticular deposition can only be considered to be a continuum, the amount seen in any species depends not only on the individual, but also on the optical equipment, the method of clearing the specimen, and the nature of the mounting medium. *Hoploscirus* Thor, 1937 and *Hoplomolgus* Berlese, 1923 were erected for species of *Bdellodes* (= *Scirus*) and *Neomolgus* (= *Molgus*) in which the reniform thickenings (dorsal shields of authors) could be readily detected. The distinguishing character for both genera is apparently based on an extreme modification of a continuous character, cuticular deposition.

An increased number of cheliceral setae appears only in *Neomolgus* and previously, *Bdellodes* has been considered to be the only genus having one cheliceral seta. However, this character is not sufficient to distinguish *Bdellodes*, as members of this genus have been discovered with two cheliceral setae, and in undescribed species of *Thoribdella* from Australia, the posterior cheliceral seta is vestigial in one species and wanting in another species.

A similar modification of the lateral lips of the hypostome occurs in both major groups of bdellids. In *Cyta* and *Odontoscirus*, these structures are prominent and heavily fringed apically. In other genera, the lateral lips are small and the cuticular fringe is minute (fig. 2).

INTRASPECIFIC VARIATION

A preliminary investigation of intraspecific variation demonstrated a constancy of characters, especially within local populations. Although evidence for subspecies exists in some species, until more extensive material has been gathered, it is judged advisable not to name them.

The variation found in species of wide distribution is striking. There appears to be a positive correlation between increase in body size and decrease in temperature. Generally the larger species or individuals of a given species of *Cyta, Bdella* and *Neomolgus* occur in the colder regions. Concrete data on this apparent geographical variation is presented under a few of the widespread species for which series from widely separated localities are available.

A few characters, such as striation patterns and gnathosomal structures may be unique for a species, or may be similar in more than one species. The definitive character for species differentiation appears to be the number, type and relative positions of the sensory setae of the legs. Except for the attenuate sensory setae located on the dorsal surfaces of the genua and proximal halves of the tibiae, specialized setae are extremely stable. Although these setae tend to be in slightly different positions in each specimen, their relative positions are the same. To illustrate this phenomenon, the positions of the sensory setae on tarsus I were plotted for thirty-eight specimens of *Bdella longicornis.* In figure 71, the stippled area surrounding the bases of each seta represents a composite of all the positions in which the seta occurred. Generally, all the setae migrated either up or down the tarsus, thus, even though the exact positions had changed, each seta was approximately in the same relative position to the other sensory setae.

TAXONOMY

Historical Account

Excellent historical accounts have been presented by Thor (1931), Oudemans (1937), and Vitzthum (1931a). This discussion will therefore be limited to the important systematic questions that have been created in the past.

Latreille (1795) originally described the type genus *Bdella* as having "Deux antennules filiformes, longues, coudées, de quatre articles, dont le premier et le dernier fort longs: celui-ci terminé par deux poils. Trois valvules réunies, formant un bec advancé, alongé et conique . . ." "*La pince rouge*" Geoffroy, 1762, was selected

by Latreille for the type species and the description was based primarily on Geoffroy's illustration. In the following year, Latreille (1796) synonymized "*La pince rouge*" Geoffroy, 1762, with *Acarus longicornis* Linnaeus, 1758. Controversy arises in the interpretation of the relative lengths of the two longer palpal segments, the femur and tibiotarsus. Latreille's description is ambiguous on this point, as he states only that the two segments are strongly elongated.

Geoffroy's (1762) figure depicts "*La pince rouge*" as having a four-segmented palpus: trochanter, femur (basifemur and telofemur), genu, and tibiotarsus. The palpal apices are shown to be expanded distally, obliquely truncate, with two subequal end setae slightly longer than the femora, and the tibiotarsi approximately two thirds the length of the femora. "*La pince rouge*" clearly belongs to the genus *Bdella, sensu* Thor (1931a). When Latreille's description is compared with Geoffroy's figure, the description loses its ambiguity and the following synonymy becomes probable: *Acarus longicornis* L., 1758 = "*La pince rouge*" Geoffroy, 1762 = *Bdella longicornis* Latr., 1795 = *Bdella longicornis, sensu* Thor, 1931a.

Vitzthum (1931) interprets Latreille's description as meaning that the longer segments, the femur and the tibiotarsus, are approximately equal in length, thereby placing *Bdella* in the Odontoscirinae, *sensu* Thor (1931a) and Grandjean (1938). To the present author, Vitzthum's interpretation seems incorrect.

Hermann (1804) erected the genus *Scirus* for ". . . les Mites dont Linné et Geoffroy n'ont connu qu'une seule espèce, appalée par le premier *acarus longicornis*. . . ." His type species, *Scirus vulgaris,* is figured as having short, widened palpal tibiotarsi and is considered to be synonymous with *Acarus longicornis* L. (Thor, 1931a; Oudemans, 1937; *non* Vitzthum, 1931). The genus *Scirus, sensu* Hermann must therefore be synonymized with *Bdella, sensu* Thor.

A second species described by Hermann (1804), *Scirus longirostris,* is figured as having the terminal palpal segment cylindrical, approximately as long as the femur and the end hairs approximately the length of the tibiotarsus, a condition commonly found only in the Odonotscirinae. *S. longirostris* has been regarded as the type species for *Scirus, sensu* Thor (*non* Hermann, 1804), but as *Scirus* and *Bdella* are isogenotypic, the name *Scirus* is invalid. Oudemans (1937) recognized this inconsistency and proposed the name *Bdellodes* to replace *Scirus, sensu* Thor.

Characters and Descriptive Methods

To simplify the species descriptions, characters are presented in an abbreviated form. Important morphological features used in the descriptions are discussed fully in the morphology section. For species being redescribed, the intraspecific variations in measurements and counts (*e. g.*, setae) observed in the study specimens are expressed as ranges immediately following the character being described. For new species, variations are noted in the remarks section following each description.

A phase contrast microscope was used throughout this study. A grid in the eyepiece was used to draw the figures to scale.

Following the same sequence as will be found in the formal descriptions that follow, the characters and descriptive methods are explained in the following section.

Color in life, which has been extensively used as a taxonomic character by earlier workers, is apparently dependent on body contents in most species. Although no experiments were undertaken to demonstrate that bdellids change color on different diets, the author noted that *Cyta coerulipes,* the only species with a purple integument, in life varied from purple to brown with yellow blotches. A few species have black, subcutaneous spots beneath the lateral eyes, but these disappear after the specimens have been treated with lacto-phenol clearing solution.

Length, including gnathosoma is a highly variable measurement. Nongravid females and males are approximately the same size, but the hysterosoma of gravid females becomes greatly distended, thereby creating an erroneous impression of the species size.

Palpus. Illustrations are of the median aspect of the left palpus. Measurements of the palpal segments were taken from the dorsal surfaces and are given in the following order: trochanter (I), basifemur (II), telofemur (III), genu (IV), tibiotarsus (V), dorsal end seta (*des*), and ventral end seta (*ves*). Variations in the number of setae are indicated in the remarks section following each description.

Chelicera. The shape of the chelicera may be normal, which means that it is approximately three to five times as wide at the base as at the thinnest portion (fig. 12). Inflated chelicera indicates that the width at the base is more than seven times greater than at the thinnest portion (fig. 13), and elongated chelicera has sides that are approximately parallel (figs. 32-35). The chelae in the majority of the genera are small and the ventral, movable digit sickle-shaped (fig. 7*b*). Smooth chelae means that the blades lack teeth on the

inner surfaces. In the Odontoscirinae, the inner surface of the movable digit may be flattened subapically. This flattened surface extends proximally to the level of the tip of the fixed digit (fig. 8). The length of a chelicera is measured from the base to the apex of the longest digit.

Hypostome. As viewed from the ventral aspect (fig. 2), the gnathosoma consists of a rectangular base carrying the palpal articulations at the anterolateral angles, and an anteriorly projecting hypostome. The latter structure consists of a long, tapering buccal cone, and two small, distally fringed lateral lips. The gnathosomal base is always transversely striated, but the buccal cone may be striated or nonstriated. In the latter case, the integument may appear to be granulated. In adults, there are two, six or seven pairs of large setae in two longitudinal series on the ventrolateral surfaces of the hypostome that extend from the anterior margin of the gnathosomal base to the proximity of the lateral lips. These setae, the ventral hypostomals, are indicated as the *vh* series and are numbered consecutively from the base, thus, the proximal pair of setae is *vh 1*. The positions of the ventral hypostomal setae may be important in future taxonomy, therefore, relative positions are indicated in the descriptions. Two dorsal hypostomal setae may be present beneath the cheliceral bases. If present, these setae are inserted approximately above the palpal articulations. The lengths of the dorsal hypostomal setae are compared to the lengths of the setae comprising the ventral series.

Propodosoma. The integumental striae of this area, although not always specific, appear in different structural types and patterns. The breaks along the crests of these integumental ridges vary in frequency and regularity and on this basis have been divided into three categories. Sparsely broken striae (fig. 136) indicates that the breaks occur at long and irregular intervals. Coarsely broken striae (fig. 151) divide at regular intervals with the lengths of the uninterrupted crest approximately six to eight times longer than the breaks. Finely broken striae (fig. 133) indicates that the undivided lengths of the crests are only two to three times longer than the breaks. Although it might be expected that many intergrades would occur between these arbitrary groups, this is not the case. Intergrades occur in only one or two instances, and these are between the coarsely and finely broken striation groups.

The lateral propodosomal setae (figs. 1 *d*, 133 *c*) are inserted lateral to a line connecting the dorsal sensilla on each side. The

presence or absence of this pair is considered to be of generic significance (except *Thoribdella*). The median propodosomals (fig. 1 *f*, 133 *f*) are always present and are inserted in the interval between the posterior sensilla.

On each side of the body, the eyes may be approximate or distant and the distance between the eyes is compared to the diameter of either the anterior or posterior eyes. In *Bdella* and *Spinibdella*, the direction of the striae in the interocular interval may be longitudinal, thus connecting the eyes, or transverse.

Dorsal hysterosoma. The interval between an internal humeral and an internal dorsal seta (fig. 1 *h, j*) is considered to be the first interspace and is used as a comparison with the length of the humeral seta.

Anal region. The border striae are those striae which parallel the entire length of the anal cleft or those which bend sharply laterad near the center of the cleft. Setae inserted in the region of the parallel striations are the anal setae (fig. 2 *j*). A pair of postanal setae (fig. 1 *o*) flanks the dorsal termination of the cleft. Other setae surrounding the anal cleft are considered to be the paranal setae.

Genital region. Two membraneous plates or flaps cover the genital vestibule, each of which has a regular or irregular row of genital setae (figs. 2 *i*, 178 *a*). Setae surrounding these plates are the paragenital setae (figs. 2 *g*, 178 *b*), and although a few of these setae occur between the coxae, no satisfactory division could be made to separate these setae into groups of paragenitals and intercoxals. In the Cytinae, an unpaired median seta occurs immediately anterior to the genital flaps (fig. 178 *c*).

Setae inserted on the ovipositor are indicated by position. Those surrounding the apex are termed the subapical setae, and those slightly distal to the midlength of the ovipositor are termed the postmedial setae.

The large, heavily sclerotized amphioid sclerites of the male each bears a peripheral row of setae of various lengths and shapes (figs. 169-177). In *Spinibdella* and *Cyta*, the differences in the peripheral setae are believed to be specific. In other genera, setal differences could not be evaluated. However, in this latter group of genera, the setae are divided into distinct groups and are recorded as such in the descriptions. For example, "amphioid sclerites with 4, 1, 3, 2" would indicate that in the peripheral row of

setae, a group of four setae are anterior, then a single seta, then a group of three setae, and finally near the caudal termination of the sclerite, two setae.

Legs. Small or minute lateral rays on the claws refers to a row of tiny spines, each of which is approximately the width of the claw. Large lateral rays are similar in structure to the above, but are less numerous and more than three times the width of the claw (fig. 70). Measurements of the legs are given in microns for the tibia and tarsus (excluding the pretarsus) of legs I and II. The chaetotaxy is given for each segment, starting with coxa I. If only one type of seta occurs on more than one segment of a series (*e. g.*, coxae), this is indicated in an abbreviated form. For example, "coxae I-IV, 5, 4, 6, 4 tactile setae" means that only tactile setae occur on the coxae and coxa I has five tactile setae, coxa II has four tactile setae, etc. When segments have more than one type of seta, each segment is given individually. The different types of setae found on the legs are illustrated in figs. 179-197.

Description of the Family Bdellidae

Bdellei Dugès, 1834, Ann. Sci. Nat., ser. 2, vol. 1, Zool., p. 21.

Medium to large mites (approximately 0.5 to 3.5 mm.) with finely striated integument (*Trachymolgus* armored); subcutaneous shields may be present on the propodosoma; conelike gnathosoma formed by elongated, chelate chelicerae bearing one or more setae, and a ventral hypostome bearing two, six, or seven pairs of conspicuous ventrolateral setae and two pairs of minute setae inserted on the lateral lips; geniculate palpi five-segmented, trochanter and genu short, femur divided distally into a short telofemur and a long basifemur; tibiotarsus of various lengths and bears apically two long setae (one in *Monotrichobdella*); tracheal openings near cheliceral bases; idiosoma divided dorsally into propodosoma and hysterosoma; four dorsal sensilla inserted in pseudostigmatic organs; two, four, or five eyes present; legs eight-segmented (including short pretarsus) with two claws and a padlike, rayed puvillus; maximally five pairs of trichoboths; well developed genital tracheae may be present; three pairs of genital suckers; anal cleft terminal; sexes similar. The subfamilies erected by Grandjean (1938) are incorporated in the following generic key.

Key to the Genera of the Family Bdellidae

1. Venter of hypostome with six or seven pairs of strong setae and two pairs of small adornal setae; without well developed genital tracheae 2
   Venter of hypostome with two pairs of strong setae and two pairs of small adornal setae; with well developed genital tracheae 7
2. Trichoboth absent on tibia II ..... (Bdellinae) *Bdella* p. 372
   Trichoboth present on tibia II ..... (Odontoscirinae) 3
3. Each chelicera with more than two setae, usually eight to twenty ..... *Neomolgus* p. 389
   Each chelicera with one or two setae 4
4. Posterior pseudostigmata goblet-shaped; posterior sensilla reduced in size, usually much shorter than median propodosomal setae ..... *Thoribdella* p. 394
   Posterior pseudostigmata simple; posterior sensilla not reduced in size and longer than median propodosomal setae 5
5. Lateral propodosomal setae present ..... *Octobdellodes* p. 407
   Lateral propodosomal setae absent 6
6. Chela with inner surface of movable digit straight and bearing one or more small teeth; cheliceral bases inflated; lateral lips of hypostome prominent ..... *Odontoscirus* p. 386
   Chela with movable digit sickle-shaped and bearing one or no teeth; cheliceral bases not inflated; lateral lips of hypostome as in other genera ..... *Bdellodes* p. 412
7. Cheliceral bases normal to inflated, chela with movable digit sickle-shaped; unpaired median seta immediately anterior of genital opening ..... (Cytinae) 8
   Chelicerae elongated; chelae with digits reduced, needlelike; unpaired median seta, if present, between coxae IV ..... (Spinibdellinae) 9
8. Integument soft, striated; chelae massive; unpaired median eye between anterior sensilla ..... *Cyta* p. 416
   Integument armored, pitted; chelae not massive; without unpaired median eye ..... *Trachymolgus* p. 423
9. Lateral propodosomal setae present; palpal tibiotarsus expanded distally (truncated) ..... *Spinibdella* p. 424
   Lateral propodosomal setae absent; palpal tibiotarsus cylindrical, elongated 10
10. Palpal tibiotarsus with two long apiacl setae ..... *Biscirus* p. 435
    Palpal tibiotarsus with one long apical seta ..... *Monotrichobdella* p. 438

Bdellinae Grandjean, 1938

The Bdellinae, containing only the genus *Bdella,* is characterized by having six pairs of ventral hypostomal setae, four pairs of trichoboths (*Bdella mexicana* has three pairs), and undeveloped genital tracheae. No exceptions were found in the material examined; however, Vitzthum (1943) reports an undescribed species of *Bdella* which has one pair of weakly developed genital pouches.

Genus *Bdella* Latreille

Bdella Latreille, 1795, Magasin encyclopédique, ou Journal des Lettres et des Arts, Paris, vol. 4, p. 18. (Type: *Acarus longicornis* Linnaeus, 1758, by subsequent identification, Latreille, 1796, Précis des Caractères génériques des Insectes, disposés dans un Ordre naturel, par [Pierre André] Latreille, Paris, p. 180).

Chelifer Geoffroy, 1762, Histoire abrégée des Insectes, qui se trouvent aux Environs de Paris; dans laquelle ces Animaux sont rangés suivant un Ordre méthodique, par Etienne Louis Geoffroy, vol. 2, p. 617. (Type: *Chelifer totus ruber, antennis extremo bisetis: Pince rouge* Geoffroy, 1762 [= *Acarus longicornis* L.] [monobasic].)

Scirus (Ciron) Hermann, 1804, Mémoire aptérologique. Ouvrage couronné en 1790 par la Société d'Histoire naturelle de Paris, Publié par Fréderic-Louis Hammer, Strasbourg, p. 60. (Type: *Scirus vulgaris* Hermann, 1804 [= *Acarus longicornis* L.] [first included species].)

Bdellidium Oudemans, 1929, Ent. Ber. Nederl. Ver., vol. 7, p. 449 (new synonym). (Type: *Scirus vulgaris* Hermann, 1804 [= *Acarus longicornis* L.] [by original designation].)

Caenobdella Oudemans, 1937, Kritisch Historisch Overzicht der Acarologie, Leiden, vol. 3, part C, p. 1227 (new synonym). (Type: *Bdella crassipes* C. L. Koch, 1839 [by original designation].)

In addition to the subfamily characters, the palpal tibiotarsus is truncate and considerably shorter than the palpal basifemur; the subequal end setae are as long as or longer than the palpal femur. Normal to inflated chelicerae bear two setae inserted on the proximal three fourths of their lengths, and the small chelae have sickle-shaped movable digits, each of which may have one small tooth. The dorsal propodosoma with four pairs of eyes lateral to the unmodified posterior pseudostigmatic organs. The podocephalic canal is an external groove (Grandjean, 1938).

The genus *Caenobdella* Oudemans is based on the inadequate description of *Bdella crassipes* Koch, 1839. Koch's illustration shows five trichoboths on the right side of the animal and four trichoboths on the left side. The trichoboths of legs III, one pair inserted on tibiae III, one on the right tarsus III, are the distinguishing features of *Caenobdella*. In this author's opinion, these discrepancies represent mistakes made by Koch, and therefore, should not be considered to represent significant structures.

KEY TO THE SPECIES OF BDELLA

1. Distance between anterior sensilla bases less than between posterior sensilla; striae of propodosomal shield, if longitudinal, not directed between anterior sensilla 2
   Distance between anterior sensilla bases greater than between posterior sensilla; striae of propodosomal shield longitudinal, directed between anterior and posterior sensilla 5
2. Propodosomal shield with all striae convex caudally 3
   Propodosomal shield with anterior striae convex caudally, posterior striae longitudinal, directed between posterior sensilla 4

3. Shield with finely broken striae; palpus with thirteen or more setae on basifemur, seven setae (including end setae) on tibiotarsus *longicornis* p. 373
   Shield with sparsely broken striae; palpus with eight to eleven setae on basifemur, six setae (including end setae) on tibiotarsus *muscorum* p. 375
4. Telofemur, genu, and tibia of leg I approximately equal in length, genu I without duplex seta *tropica* p. 378
   Tibia I two times longer than genu I or telofemur I; genu I with duplex seta *longistriata* p. 380
5. Tarsus IV with trichoboth; dorsal hysterosomal setae branched distally; transverse striae between eyes *distincta* p. 381
   Tarsus IV without trichoboth; dorsal hysterosomal setae nude or plumose; longitudinal striae between eyes *mexicana* p. 383

Bdella longicornis Linnaeus

(Figs. 7, 12, 37, 69-72, 133-135, 169)

Acarus longicornis Linnaeus 1758, Systema Naturae, 10th ed., p. 618.
"Chelifer totus ruber, antennis extremo bisetis; Pince rouge" Geoffroy, 1762, Hist. Abr. Ins., vol. 2, pp. 618-619.
Scirus vulgaris Hermann, 1804, Méin, Apt., p. 61.
Bdella anguinesetosa Ewing, 1910, Univ. Stud., Univ. Illinois, vol. 3, no. 6, p. 72 (new synonym).
Bdella tessellata Ewing, 1913, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 112 (new synonym).

This widespread species is closely related to *Bdella muscorum* Ewing, 1909, and to *Bdella iconica* Berlese, 1923. *B. longicornis* can be distinguished from *B. muscorum* by having seven setae (including two apical setae) on the palpal tibiotarsus rather than six, and in having the interlacing secondary apodemes of the dorsal propodosomal shield lateral to the bell-shaped primary apodemes (fig. 133) rather than mesad (fig. 136). The palpal tibiotarsus of *B. iconica* is identical to that of *longicornis*, but the striae of the propodosomal shield are convex caudad in *longicornis* rather than being directed between the median propodosomal setae.

Female: Color in life, deep pink to red, with irregular brown to dark blue blotches. Body ovoid, weakly constricted; length, including gnathosoma, 1160 μ (850-1475 μ). *Gnathosoma:* Length, 320 μ (209-396 μ); palpus (fig. 37) with tibiotarsus extending beyond hypostome; measurements: I, 15 μ (11-16 μ); II plus III, 327 μ (142-371 μ); IV, 30 μ (20-38 μ); V, 95 μ (54-115 μ); *des*, 243 μ (187-464 μ); *ves*, 195 μ (141-367 μ). Chelicera (figs. 7, 12) normal, finely striated, 300 μ (193-423 μ) in length; movable digit smooth, equal in length to fixed digit; setae as in fig. 12. Hypostome striated; *vh 1* and *vh 2* form transverse row between palpal articulations; dorsal hypostomals wanting. *Dorsal propodosoma*

(figs. 133-135): Striae finely to coarsely broken; lateral propodosomals nude, 57 μ (43-100 μ); median propodosomals nude, 67 μ (57-128 μ) in length; eyes separated by diameter of anterior pair; distance between anterior sensilla, 74 μ (56-143 μ); large pore anterolaterad to lateral propodosomal seta. *Dorsal hysterosoma:* Setae nude; internal humeral, 70 μ (57-116 μ) in length, approximately the length of first interspace; external humeral, 99 μ (70-184 μ) in length; sacrals and clunals in gently curving rows. *Anal region:* Border striae parallel; one pair of anals; 5 pairs of paranals; postanals anterior to cleft, longer than external clunals. *Genital region:* Each genital plate with 7 (6-8) equal genital setae in irregular linear arrangement; 9 (10) pairs of paragenitals, anterior pair not between coxae IV; genital discs small, equidistant, in posterior two thirds of vestibule; ovipositor with 10 subapical and 10 postmedial setae. *Legs* (figs. 69-72): Claws with 4-5 lateral rays, 1 row of minute rays each; measurements: tibia I, 114 μ (65-180 μ); tarsus I, 146 μ (100-201 μ); tibia II, 87 μ (52-143 μ); tarsus II, 125 μ (83-180 μ). Chaetotaxy: coxae I-IV, 6 (5), 6 (5), 5, 3 (4) tactile setae; trochanters I-IV, 1, 1, 2, 2 tactile setae; basifemora I-IV, 13 (11-17), 11 (11-15), 11 (11-14), 6 (7) tactile setae; telofemora I-IV, 11 (11-13), 11 (11-13), 11 (12), 9 (9-11) tactile setae; genu I, 9 (8) tactile setae, 1 duplex seta, 3 (3-6) attenuate sensory setae; genu II, 9 tactiles, 1 duplex, 1 (2) attenuate sensory setae; genu III, 9 tactiles, 1 duplex, 1 attenuate sensory seta; genu IV, 10 (11) tactiles, 1 attenuate sensory seta; tibia I, 16 tactiles, 5 (5-9) attenuate sensory setae, 1 attenuate peg, trichoboth; tibia II, 15 (13-15) tactile setae, 2 attenuate sensory setae, one blunt sensory seta; tibia III, 16 (17) tactile setae, one attenuate sensory seta; tibia IV, 15 tactiles, trichoboth; tarsus I, 14 (16) ventrals, distal pairs plumose, 10 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 attenuate peg, dorsoterminals minutely plumose; tarsus II, as in tarsus I, except lacking 2 attenuate sensory setae and 1 lateral seta; tarsus III, 14 ventrals, distal pairs plumose, 9 laterals, trichoboth, dorsoterminals as in leg I; tarsus IV, 14 ventrals, 7 (8) laterals, trichoboth, 1 attenuate sensory seta distal to trichoboth, *dt 1* reduced to one seta, *dt 2, 3* minutely plumose.

Male: Identical to female; amphioid sclerites (fig. 169) with 7, 1, 2 setae each.

Type: Europe.

Location of type: Unknown.

Remarks: Two of H. E. Ewing's types available for study from the U. S. National Museum were: *Bdella anguinisetosa* (tritonymph), June 5, 1905, H. E. Ewing; and *Bdella tessellata* (female), Portage, Wisconsin, September 2, 1909, H. E. Ewing, under an old piece of bark.

In addition, approximately 250 specimens were examined, which included material from: Barro Colorado Island, Panama Canal Zone, Costa Rica, Cuba, Mexico (Oaxaca, Distrito Federal, México, San Luis Potosí), United States (California, Texas, Utah, Arkansas, Kansas, Illinois, Tennessee, Florida, Missouri, Michigan, New Hampshire, Vermont), and Nova Scotia.

The numbers of setae on the palpal segments are: basifemur, 14 (13-15); telofemur, 1; genu, 4; tibiotarsus, 4 tactile setae, 1 attenuate sensory seta, and two long apical setae. The length of the solid tactile seta on the dorsal surface of the palpal tibiotarsus is slightly longer, to more than twice the length of the attenuate sensory seta.

The variation in total length is considerable, but more striking is the variation in cuticular deposition shown by the internal apodemes of the dorsal propodosoma (figs. 133-135). Geographical variation could not be demonstrated in this species. Within one area, individual mites could be found which exhibited all combinations of the variable characters.

The illustrations were prepared from females from: West slope of Cortez Pass, Mt. Popocatepetl, México, Mexico, August 11, 1954, W. T. Atyeo, moss sample off tree (Berlese funnel extraction), alt. 11,500 ft.

Bdella muscorum Ewing

(Figs. 39, 73, 74, 136-139)

Bdella muscorum Ewing, 1909, Canadian Ent., vol. 41, no. 4, pp. 124-125.
Bdella lata Ewing, 1910 (*non* Koch & Berendt, 1854, fossil *Bdella?*), Univ. Stud., Univ. Illinois, vol. 3, no. 6, p. 69.
Bdella subnigra Ewing, 1910, Univ. Stud., Univ. Illinois, vol. 3, no. 6, p. 73 (new synonym).
Bdella muscorum var. *minnesotensis* Ewing, 1913, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 113 (new synonym).
Bdella recens Ewing, 1937 (*pro, Bdella lata* Ewing, *nom praeocc.*), Univ. Toronto Stud., Geological Ser., no. 40, p. 57 (new synonym).

This species is closely related to *Bdella longicornis*, and due to many superficial similarities, these two species may be easily confused. In addition to differences in the chaetotaxy of the legs, *B. muscorum* can be easily differentiated by the palpal chaetotaxy, the basifemur having eight to eleven setae and the tibiotarsus having a total of six setae. The palpus of *B. longicornis* has thirteen or more setae on the basifemur and seven setae on the tibiotarsus.

Female: Color unknown. Body ovoid, weakly constricted; length, including gnathosoma, 825 μ (710-1170 μ) *Gnathosoma:* Length, 224 μ (206-331 μ); palpus (fig. 39) with tibiotarsus extending beyond hypostome; measurements: I, 15 μ (13-18 μ); II plus III, 135 μ (133-198 μ); IV, 26 μ (20-35 μ); V, 60 μ (55-99 μ); *des,* 175 μ (110-220 μ); *ves,* 129 μ (129-182 μ). Chelicera normal, finely striated, 215 μ (207-300 μ) in length; chela smooth, fixed digit blunt, slightly shorter than movable digit; distal seta extending to base of chela, proximal seta extending to insertion of distal seta; setae inserted as in fig. 12. Gnathosoma striated; *vh 1-2* in strongly curved transverse row between palpal articulations, *vh 2, 3, 5, 6* progressively more widely separated and form 2 longitudinal series, *vh 1, 4* laterad of series; dorsal hypostomal setae wanting. *Dorsal propodosoma* (figs. 136-139): Striae sparsely broken; lateral propodosomals nude, 57 μ (47-78 μ) in length; median propodosomals nude, 74 μ (71-99 μ) in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes with longitudinal striae; distance between anterior sensilla, 70 μ (61-97 μ). *Dorsal hysterosoma:* Setae nude; length of internal humeral, 79 μ (79-98 μ), approximately three fourths of first interspace; external humeral, 105 μ (92-124 μ) in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae parallel, 2 pairs of anal setae, 5 (4) pairs of paranals anterior to termination of cleft, longer than external clunals. *Genital region:* Each genital plate with 8 (9) small equal genital setae in linear arrangement; 10 pairs of paragenitals, anterior pair not between coxae IV; genital discs small, approximately equidistant, in posterior three fourths of vestibule; ovipositor with 10 subapical and 8 postmedial setae. *Legs* (figs. 73, 74): Claws with 4-6 lateral rays, one row of minute rays each; measurements: tibia I, 74 μ (64-100 μ); tarsus I, 90 μ (85-124 μ); tibia II, 53 μ (45-82 μ); tarsus II, 75 μ (71-108 μ). Chaetotaxy: coxae I-IV, 5 (6), 6 (5), 5 (7), 4 (3) tactile setae; trochanters I-IV, 1, 1 (2), 2, 2 tactile setae; basifemora I-IV, 10 (8-14), 8 (7-10), 9 (8), 5 (6) tactile setae; telofemora I-IV, 7 (8-11), 7 (6-10), 7 (8-9), 8 (7) tactile setae; genu I, 6 (6-8) tactile setae, 1 (2) attenuate sensory seta(e), 1 duplex seta; genu II, 6 (6-8) tactiles, 1 duplex; genu III, 6 (6-8) tactiles, 1 duplex; genu IV, 8 tactiles, 1 attenuate sensory seta; tibia I, 14 (13) tactiles, 4 attenuate sensory setae, 1 peg, trichoboth; tibia II, 11 tactiles, 2 (1) attenuate sensory seta(e), 1 blunt sensory seta; tibia III, 12 (10-14) tactiles, 1 attenuate sensory seta; tibia IV, 13 (11-12) tactile setae, trichoboth; tarsus I, 13 (14)

plumose ventrals arranged in 2 rows, 8 lateral and 2 dorsal tactiles, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* hollow, nude, *dt 2, 3,* solid, plumose; tarsus II, 10 (11-12) plumose ventrals, 6 lateral and 2 dorsal tactiles, 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, 12 (11) ventrals, 7 (6-8) laterals, trichoboth, *dt 1* solid, nude, *dt 2, 3,* solid, plumose; tarsus IV, 12 (11) ventrals, 6 laterals, 1 attenuate sensory seta, trichoboth, *dt 1* reduced to one, solid, nude seta, *dt 2, 3,* solid, plumose.

Male: Identical to female; amphioid sclerites with 6, 1, 2 setae each.

Type: Female, Muncie, Illinois, June 16, 1908, H. E. Ewing, in moss.

Location of type: The United States National Museum.

Remarks: Three additional type specimens were examined and found to be conspecific with *B. muscorum;* these were: *Bdella recens* Ewing, 1937 (*pro, B. lata,* Ewing, *nom praeocc.*), sex unknown (incomplete specimen), Mahomet, Illinois, April 17, 1908, H. E. Ewing; *B. subnigra* Ewing, 1910, female, Mahomet, Illinois, April 17, 1908, H. E. Ewing, in moss; *B. muscorum* var. *minnesotensis* Ewing, 1913, female, Minnesota, April 24, 1900. Additional material studied included specimens from: The United States (California, Colorado, New Mexico, Kansas, Arkansas, Tennessee, Michigan, Illinois, Maryland), Alaska (Point Barrow, Chandler Lake Region, Umiat, District of Mackenzie), Germany (Ost-Holstein), Czechoslovakia, and Iceland.

In the Old World specimens, the mesal margins of the dorsal propodosomal apodemes are more highly developed than the lateral margins, whereas in the New World material, the reverse is true (fig. 136). However, in either condition, there is little variation in the characteristic shape of the apodemes.

As indicated in the description, the chaetotaxy of the legs is relatively constant. The chaetotaxy of the palpus is as follows: basifemur, eight to eleven tactile setae, usually ten; telofemur, one seta; genu, four setae; tibiotarsus, three tactile setae, one attenuate sensory seta, and two long apical setae. The dorsal sensory seta and the dorsal tactile seta fluctuate considerably in actual and relative lengths. The tactile seta may be slightly longer, or as in the Icelandic specimens, almost twice the length of the sensory seta. Drawings of a female from Douglas Lake, Cheboygan Co., Michigan, June 24, 1957, R. E. Beer, moss (Berlese funnel extraction).

Bdella tropica, sp. nov.

(Figs. 40, 77, 78, 140)

This species is closely related to *Bdella distincta*, but has long, nude, dorsal hysterosomal setae rather than short, distally branched setae, and has a different propodosomal striation pattern (figs. 140, 141). Although this new species does not appear to be closely related to *Bdella grandjeani* Thor (1931b) from Tanganyika, the propodosomal striae form similar patterns in both species.

Female: Color in life unknown. Body narrowly ovoid, weakly constricted; length, including gnathosoma, 810 μ. *Gnathosoma:* Length, 211 μ; palpus (fig. 40) short, only apex of tibiotarsus extending beyond hypostome; measurements: I, 12 μ; II plus III, 121 μ; IV, 24 μ; V, 45 μ; *des*, 175 μ; *ves*, 153 μ. Chelicera normal, finely striated, 204 μ in length; chela smooth, fixed digit attenuate, extending slightly beyond movable digit; distal seta extending to base of chela, slightly longer than proximal seta; setae inserted as in *Bdella longicornis* (fig. 12). Gnathosoma faintly striated; ventral setae in two longitudinal series, *vh 1* between palpal articulations, distance between *vh 1* and *vh 2* equal to distance between *vh 5* and *vh 6*, distance between *vh 2* and *vh 3* equal to one half distance between *vh 3* and *vh 4* or *vh 4* and *vh 5;* dorsal hypostomal setae delicate, same length as proximal pair of ventral setae. *Dorsal propodosoma* (fig. 140): Striae finely broken; lateral propodosomals nude, 56 μ in length; median propodosomals nude, 125 μ in length; eyes approximate, separated by 3 transverse striae; distance between anterior sensilla, 92 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 75 μ, approximately five sixths of first interspace; external humeral, 238 μ in length; sacrals and clunals in gently curving transverse rows. *Genital region:* Each genital plate with 8 small, equal, genital setae in linear arrangement, 9 pairs of paragenitals, anterior pair between coxae IV; genital discs small, anterior pair near center of vestibule, posterior two pairs approximate, near caudal end; ovipositor with 10 subapical and 8 postmedial setae. *Anal region:* Border striae bending laterad; one pair of anal setae anterior, one pair posterior to laterally-directed striae; one pair of paranals; postanals flanking termination of cleft, shorter than clunal setae. *Legs* (figs. 77, 78): Claws with 2-3 basal, lateral rays and one row of minute rays each; measurements: tibia I, 51 μ; tarsus I, 91 μ; tibia II, 38 μ; tarsus II, 79 μ. Chaetotaxy: coxae I-IV, 6, 5, 6, 4 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 8, 9, 7, 4 tactile setae; telofemora I-IV, 5 tactile setae

each; genu I, 5 tactile setae, 2 attenuate sensory setae, 1 duplex seta; genua II-III, 6 tactile setae and 1 duplex seta each; genu IV, 5 tactile setae, 1 duplex seta; tibia I, 7 tactile setae, 3 attenuate sensory setae, 1 attenuate peg, trichoboth; tibia II, 7 tactile setae, 2 attenuate sensory setae, 1 blunt sensory seta; tibia III, 8 tactile setae, 1 attenuate sensory seta; tibia IV, 10 tactile setae, trichoboth; tarsus I, 9 plumose ventral setae arranged in 2 rows, 7 lateral and 2 dorsal tactile setae, 2 blunt and 2 attenuate sensory setae, 1 hollow, blunt peg, *dt 1* hollow, pilose, *dt 2, 3* solid, plumose; tarsus II, 8 plumose ventrals, 4-5 lateral and 2 dorsal tactile setae, 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, 10 plumose ventrals, 6 laterals, trichoboth, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus IV, 10 plumose ventrals, 5 laterals, trichoboth, 1 attenuate sensory seta distal to trichoboth, dorsoterminals as in tarsus III.

Male: Unknown.

Holotype: Female, Barro Colorado Island, Canal Zone, Panama, July 27, 1956, Carl W. Rettenmeyer, bark moss (Berlese funnel extraction).

Paratypes: Twenty-three females from Barro Colorado Island, Canal Zone, Panama, collected by Carl W. Rettenmeyer by Berlese funnel extraction with the following data: nine females, same data as the holotype; eight females collected July 24, 1956, rotten stump; three collected July 10, 1956, grass roots from clearing; two collected August 1, 1956, soil and leaves; one collected March 26, 1956, rotten stump; one collected July 28, 1956, dirt and leaves. Also, four females, Barro Colorado Island, May 12, 1956, C. W. and M. E. Rettenmeyer, colony E:148, *Eciton burchelli*, refuse deposit.

Location of types: The holotype and twenty-one paratypes are deposited in the Snow Entomological Museum; two paratypes are deposited at each of the following institutions: the United States National Museum, the British Museum (Natural History), and the South Australian Museum.

Remarks: Little variation is apparent in this species. The length, including the gnathosoma, varies from 780 μ to 910 μ, and other measurements vary proportionately, *e. g.*, the palpal femur, 112 μ to 124 μ. The number of tacitle setae on the leg segments vary from one more, to one less, than the number indicated in the description of the holotype. This species, collected only on Barro Colorado Island, may be restricted to the tropical regions, hence the name *tropica*. Drawings of the holotype.

Bdella longistriata, sp. nov.

(Figs. 38, 75, 76, 151, 170)

This species may be related to *Bdella tropica,* sp. nov., but can be easily distinguished by the lack of long setae on the dorsal surface of the palpal tibiotarsus.

Female: Color in life unknown. Body ovoid, weakly constricted; length, including gnathosoma, 902 μ. *Gnathosoma:* Length, 252 μ; palpus (fig. 38) with tibiotarsus extending beyond hypostome; measurements: I, 17 μ; II plus III, 190 μ; IV, 21 μ; V, 48 μ; *des,* 255 μ; *ves,* 204 μ. Chelicera normal, finely striated, 274 μ in length; chela smooth, fixed digit attenuate, slightly shorter than movable digit; distal seta extending three fourths of distance to base of chela, proximal seta extending one half the distance to distal seta; setae inserted as in fig. 12. Gnathosoma striated; *vh 1-6* in two longitudinal series, *vh 1* between palpal articulations, *vh 1-5* approximately equidistant, *vh 6* midway between *vh 5* and apex; dorsal hypostomal setae wanting. *Dorsal propodosoma* (fig. 151): Striae sparsely broken; lateral propodosomals nude, 60 μ in length; median propodosomals thickened, nude, 146 μ in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes transversely striated; distance between anterior sensilla, 92 μ. *Dorsal hysterosoma:* Setae thickened, nude; length of internal humeral, 98 μ, approximately one fourth longer than first interspace; external humeral, 153 μ in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae parallel; anal setae wanting; 2 pairs of paranals; postanals flanking termination of cleft, equal in length to external clunals. *Genital region:* Each genital plate with eleven equal setae in linear arrangement; 9 pairs of paragenitals, anterior pair between coxae IV; genital discs small, widely separated, one pair at each end of vestibule, one pair near middle; ovipositor with 10 subapical, 8 postmedial setae. *Legs* (figs. 75, 76): Claws with one row of small, lateral rays each; measurements: tibia I, 81 μ; tarsus I, 108 μ; tibia II, 60 μ; tarsus II, 102 μ. Chaetotaxy: coxae I-IV, 5, 4, 6, 5 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 11, 12, 9, 4 tactile setae; telofemora I-IV, 9, 9, 9, 6 tactile setae; genu I, 7 tactile setae, 1 duplex seta, 1 attenuate sensory seta; genua II-IV, 8 tactile setae, 1 duplex seta each; tibia I, 12 tactile setae, 2 attenuate sensory setae, 1 attenuate peg, trichoboth; tibia II, 12 tactile setae, 1 attenuate and 1 blunt sensory seta; tibia III, 9 tactile setae, 1 attenuate sensory seta; tibia IV, 13 tactile setae, trichoboth; tarsus I, 11 plumose ventrals in 2 rows, 10 lateral

and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 attenuate peg, dorsoterminals solid, minutely pilose; tarsus II, 10 plumose ventrals, 7 lateral and 2 dorsal tactile setae, 2 blunt sensory setae, 1 attenuate peg, dorsoterminals as in tarsus I; tarsus III, 12 plumose ventrals, 8 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 12 plumose ventrals, 6 laterals, trichoboth, 1 attenuate sensory seta proximal to trichoboth, dorsoterminals as in tarsus I.

Male: Identical to female except in total length and genital region; length, including gnathosoma, 880 μ. *Genital region:* Thirteen equal setae in linear arrangement on each genital plate; 10 paragenitals, anterior pair between coxae IV; genital discs small, widely separated; genital aperture large, about one half the length of the hysterosoma; amphioid sclerites (fig. 170) extending from between coxae IV to near the ventral termination of anal cleft.

Holotype: Female, 8 miles north of Llera, Tamaulipas, Mexico, July 19, 1954, W. T. Atyeo, beating pineapple epiphyte on mesquite.

Allotype: Male, Cuidad del Maiz, San Luis Potosí, Mexico; at Laredo, Texas, July 10, 1945, T. P. Chapman, on orchid plants.

Paratypes: One male, one female, 8 miles west of Antiguo Morelos, Tamaulipas, Mexico, July 21, 1954, W. T. Atyeo, under log; one female, Mante, Tamaulipas, Mexico; at Laredo, Texas, March 28, 1945, C. D. Babb, on orchid plants.

Location of types: The holotype and two paratypes deposited in the Snow Entomological Museum, the allotype and one paratype at the United States National Museum.

Remarks: Except for the number of setae on the male genital plates, which vary from twelve to thirteen pairs, and a slight variation in the number of tactile setae on the leg segments, characters in this species appear to be constant. Total length varies from 902 μ to 994 μ. This species is named *longistriata* to call attention to the almost uninterrupted striae in the dorsal propodosomal pattern. Drawings of the holotype.

Bdella distincta Baker and Balock

(Figs. 41, 79, 80, 141)

Bdella distincta Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 179.

This species is closely related to *Bdella mexicana,* but has distally branched dorsal hysterosomal setae, rather than long nude or long plumose setae and has finely broken striae rather than sparsely broken to continuous striae on the dorsal propodosoma.

Female: Color in life unknown. Body narrowly ovoid, strongly constricted; length, including gnathosoma, 858 μ. *Gnathosoma:* Length, 202 μ; palpus (fig. 41) short, distal two thirds of tibiotarsus extending beyond hypostome; measurements: I, 10 μ; II plus III, 129 μ; IV, 29 μ; V, 54 μ; *des*, 139 μ; *ves*, 126 μ. Chelicera normal, finely striated, 187 μ in length; chela smooth, fixed digit attenuate, both digits of equal length; distal seta extending to base of chela, proximal seta extending half the distance to distal seta; setae inserted as in fig. 13. Hypostome nonstriated; ventral setae approximately equidistant, arranged in two longitudinal series, *vh 1* between palpal articulations; dorsal hypostomals slightly shorter than *vh 1*. *Dorsal propodosoma* (fig. 141): Striae finally broken; lateral propodosomals thickened, sparsely branched near apex, 51 μ in length, median propodosomals branched distally as in fig. 182, 53 μ in length, eyes separated by distance equal to diameter of anterior pair, space between eyes with transverse striae; distance between anterior sensilla, 95 μ. *Dorsal hysterosoma:* Setae branched distally, as in fig. 182; length of internal humeral, 49 μ, approximately one half of first interspace; external humeral, 61 μ in length; sacrals in gently curving transverse row, clunals in strongly curving transverse row. *Anal region:* Border striae bending laterad; one pair of anal setae near anterior termination of cleft; one pair of distally branched paranals posterior to laterally directed striae; postanals branched, flanking termination of cleft, slightly shorter than external clunals. *Genital region:* Each genital plate with 8 small, equal setae in linear arrangement: 9 pairs of paragenitals, anterior pair between coxae IV; genital discs small, anterior pair one fourth the length of vestibule from anterior end; two posterior pairs approximate, immediately caudad of middle of vestibule; ovipositor with 12 subapical, 6 postmedial setae. *Legs* (figs. 79, 80): Claws with one row of small lateral rays each; coxae nonstriated; measurements: tibia I, 51 μ; tarsus I, 75 μ; tibia II, 32 μ; tarsus II, 72 μ. Chaetotaxy: coxae I-IV, 5, 4, 4, 3 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 8, 9, 7, 3 tactile setae; telofemora I-IV, each with 1 large, dorsal, branched seta plus 4, 5, 5, 3 tactile setae; genu I, 4 tactiles, 2 attenuate sensory setae; genua II-IV, 5 tactile setae, 1 attenuate sensory seta each; tibia I, 7 tactiles, 3 attenuate sensory setae, 1 attenuate peg, trichoboth; tibia II, 8 tactiles, 1 attenuate and 1 blunt sensory seta; tibia III, 7 tactiles, 1 attenuate sensory seta; tibia IV, 7 tactiles, trichoboth; tarsus I, 10 plumose ventrals in 2 rows, 5 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt

sensory setae, 1 hollow, blunt peg, *dt 1* scaly, *dt 2, 3* minutely plumose; tarsus II, 8 plumose ventrals, 5 lateral and 1 dorsal tactile setae, 2 blunt sensory setae, 1 solid peg, dorsoterminals as in tarsus I; tarsus III, 8 plumose ventrals, 4 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 8 plumose ventrals, 4 laterals, trichoboth, 1 attenuate sensory seta distal to trichoboth, dorsoterminals as in tarsus I.

Male: Unknown.

Types: Female, China, at Washington, D. C., January 29, 1941, on *Bambusa parvariabilis* tree; female, Hawaii, at Houston, Texas, October 18, 1934, O. D. Morris, in pine cones. The specimen from China is herewith designated lectotype by the present author.

Location of types: The United States National Museum, type no. 1463.

Remarks: The material examined by the present writer included specimens with the following data: two females, Mexico, at Laredo, Texas, August 24, 1945, I. A. Lane, on *Croton* cuttings; one female, Guayama, Puerto Rico, October 20, 1941, G. N. Wolcott, on *Ficus stahlii*; one female, Philippines, at Honolulu, Hawaii, April 14, 1933, on *Saccolabium violaceum;* two nymphs, Indonesia, at Washington, D. C., April 19, 1954, H. Y. Goudeman, on camellia cuttings.

The characters distinguishing this species are stable. The length, including gnathosoma, varies from 688 μ to 858 μ, and the tactile setae on the leg segments vary from one more, to one less, than the numbers indicated in the redescription. Redescription and drawings of the lectotype.

Bdella mexicana Baker and Balock

(Figs. 13, 36, 81, 82)

Bdella mexicana Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 181.
Bdella willisi Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 182 (new synonym).

This species is closely related to *Bdella distincta*, but has sparsely broken to continuous striae in the dorsal propodosomal pattern, rather than finely broken striae. *Bdella mexicana* is unique among the known species of *Bdella* in that it lacks a trichoboth on tarsus IV.

Female: Color in life unknown. Body narrow, strongly constricted; length, including gnathosoma, 560 μ. *Gnathosoma:* Length, 183 μ; palpus (fig. 36) short, distal third of tibiotarsus extending beyond hypostome; measurements: I, 11 μ; II plus III, 79 μ; IV, 20 μ; V, 48 μ; *des,* 104 μ; *ves,* 73 μ. Chelicera (fig. 13) inflated, finely stri-

ated, 148 μ in length; chela dentate, one small tooth on movable digit, fixed digit attenuate, two thirds the length of movable digit; distal seta extending to base of chela, proximal seta extending two thirds the distance to distal seta, setae as figured. Hypostome nonstriated; ventral setae in two longitudinal series, *vh 1* between palpal articulations, setae in each row approximately equidistant; dorsal hypostomal setae equal in length to *vh 1*. *Dorsal propodosoma:* Striae sparsely broken, pattern similar to *Bdella distincta* (fig. 141); lateral propodosomals nude, 30 μ in length; median propodosomals nude, 34 μ in length; eyes separated by distance equal to one half the diameter of anterior pair, space between eyes with longitudinal striae; distance between anterior sensilla, 64 μ. *Dorsal hysterosoma:* Setae minutely plumose; length of internal humeral, 45 μ, approximately one half of first interspace; external humeral, 61 μ in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae bending laterad; one pair of anal setae anterior, one pair posterior of laterally directed striae; paranals wanting; postanals flanking termination of cleft, shorter than the clunal setae. *Genital region:* Each genital plate with 8 small, equal setae in linear arrangement inserted on a longitudinal, nonstriated area; 9 pairs of paragenitals, anterior pair between coxae IV, genital discs small, anterior pair one fourth the length of the vestibule from anterior end, posterior pairs approximate, immediately caudad of middle; ovipositor with 12 subapical, 6 postmedial setae. *Legs* (figs. 81, 82): Claws with one row of short, lateral rays each; measurements: tibia I, 42 μ; tarsus I, 44 μ; tibia II, 26 μ; tarsus II, 32 μ. Chaetotaxy: coxae I-IV, 5, 4, 5, 2 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 8, 7, 7, 5 tactile setae; telofemora I-IV, 5, 5, 5, 4 tactile setae; genua I-IV, 4 tactile setae, one attenuate sensory seta each; tibia I, 6 tactile setae, 3 attenuate sensory setae, trichoboth; tibia II, 5 tactile setae, one attenuate and one blunt sensory seta; tibia III, 5 tactile setae, one attenuate sensory seta; tibia IV, 5 tactile setae, trichoboth; tarsus I, 7 plumose ventrals arranged in 2 rows, 5 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, one solid, attenuate peg, *dt 1* solid, nude, *dt* 2, 3 solid, plumose; tarsus II, 6 plumose ventrals, 3 lateral and 1 dorsal tactile seta, 2 blunt sensory setae, one solid, attenuate peg, dorsoterminals as in tarsus I; tarsus III, 6 plumose ventrals, 3 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 6 plumose ventrals, 2 laterals, 1 attenuate sensory seta, trichoboth wanting, dorsoterminals as in tarsus I.

Male: Identical to female; amphioid sclerites each with five equal setae in gently curving longitudinal row on anterior half of plate, three smaller setae in oblique row approximately two thirds the length of the plate from the anterior end.

Type: Female, Valle del Bravo, México, Mexico, March 4, 1943, Donald Dodds, moss.

Location of type: The United States National Museum, type no. 1464.

Remarks: The type of *Bdella willisi* was also examined; this specimen, a male, was collected at Laguna de Zempoala, Morelos, Mexico, January 31, 1943, by E. W. Baker, in moss. Ten additional females were available and these included specimens from Mexico (San Luis Potosí, Veracruz) and the United States (Texas, Kansas, Illinois, Maryland, New York, Connecticut).

The dorsal hysterosomals are nude in the Mexican specimens, but pilose in the individuals collected in the United States. Intergrades between these two conditions were not discovered, but presumably, they might occur in a limited area near the Texas-Mexican border. In the study specimens, the number of tactile setae on the leg segments, especially the basifemora, vary from two more to one less than the number indicated in the description of the holotype. The total length varies from 560 μ to 675 μ, and the other measurements vary proportionately. Drawings of the *mexicana* type.

Odontoscirinae Grandjean, 1938

The Odontoscirinae is characterized by six or seven pairs of ventral hypostomal setae, five pairs of trichoboths, and the absence of genital tracheae. The palpal tibiotarsus is cylindrical and usually as long or longer than the palpal basifemur. The end setae are equal or subequal and usually shorter than the palpal tibiotarsus. Normal to inflated chelicerae bear one to many setae inserted on the proximal three fourths; the chelae have the movable digits sickle-shaped (straight in *Odontoscirus*). Lateral propodosomal setae may be present or absent; secondary apodemes are usually not developed, although large amounts of cuticular deposition may form large subcutaneous plates. The striation patterns on the dorsum of the propodosoma are similar in all genera; four eyes are lateral or posterolateral to the modified or unmodified posterior pseudostigmata. The podocephalic canal is an internal tube (Grandjean, 1938).

Genus *Odontoscirus* Thor

Biscirus (*Odontoscirus*) Thor, 1913, Zool. Anz., vol. 42, no. 1, p. 29. (Type: *Bdella virgulata* Canestrini and Fanzago, 1876 [by original designation].)

The modifications of the gnathosoma are characteristic for this distinctive genus. The chelicerae are inflated; the digits are approximately equal in length, and the movable digit is basically straight and dentate. The lateral lips are much larger than the same structures in other genera (except *Cyta*). The lateral propodosomal setae are wanting. The posterior pseudostigmatic organs are unmodified and the posterior sensilla are longer than the median propodosomal setae. Legs II are shorter than legs I.

KEY TO THE SPECIES OF ODONTOSCIRUS

1. Small; chelicerae and gnathosoma striated; palpal tibiotarsus with 4 tactile setae, 1 attenuate sensory seta, and 2 long apical setae *iota* p. 386

   Large; only gnathosomal base striated; palpal tibiotarsus with 6 tactile setae, 1 attenuate sensory seta, and 2 long apical setae *alpinus* p. 388

Odontoscirus iota, sp. nov.

(Figs. 9, 16, 17, 44, 83, 84, 154)

This species is related to *Odontoscirus virgulatus* (Canestrini and Fanzago), 1876, but is about 900 μ to 1100 μ rather than 1100 μ to 2000 μ in total length. The palpal tibiotarsus of *O. iota* is approximately 120 μ in length, as compared to the same structure of *O. virgulatus*, which is approximately 250 μ long.

Female: Color unknown. Body narrowly ovoid; length, including gnathosoma, 1100 μ. *Gnathosoma:* Length, 264 μ; palpus (fig. 44) relatively short, tibiotarsus extending beyond hypostome; measurements: I, 15 μ; II, 158 μ; III, 26 μ; IV, 22 μ; V, 117 μ; *des*, 145 μ; *ves*, 150 μ. Chelicera inflated, finely striated, 255 μ in length; chela (figs. 9, 17) dentate, movable digit with 4 small teeth, fixed digit with small subapical tooth, digits of same length; setae inserted as in fig. 16. Gnathosoma striated; ventral setae in two longitudinal series; *vh 1-5* approximately equidistant, *vh 6* medial between *vh 5* and apices of lateral lips, *vh 2* between palpal articulations; *vh 1* caudad; dorsal hypostomal setae equal in length to *vh 3*. *Dorsal propodosoma* (fig. 154): Striae finely broken; median propodosomals nude, 80 μ in length; eyes separated by a distance equal to two diameters of anterior pair; distance between anterior sensilla, 66 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 65 μ, approximately one half of first interspace; external humeral,

82 μ in length; sacrals in gently curving transverse row; clunals in subrectangular arrangement. *Anal region:* Border striae parallel; one pair of anal setae; paranals wanting; postanals flanking termination of cleft, shorter than clunal setae. *Genital region:* Each genital plate with 7 equal genital setae in linear arrangement; 3 pairs of paragenitals caudad of anterior termination of aperture; genital discs small, anterior pair slightly removed from proximate posterior pairs; ovipositor with 16 subapical, 6 postmedial setae. *Legs* (figs. 83, 84): Claws with 4-5 lateral rays each, minute rays wanting; measurements: tibia I, 68 μ; tarsus I, 155 μ; tibia II, 60 μ; tarsus II, 143 μ. Chaetotaxy: coxae I-IV, 5, 2, 4, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 11, 11, 7, 3 tactiles, 5 attenuate sensory setae; genu I, 6 tactiles, 5 attenuate sensory setae; genu II, 6 tactiles, 2 attenuate sensory setae; genua III-IV, 5 tactiles and 1 attenuate sensory seta each; tibia I, 10 tactiles, 4 attenuate and 1 blunt sensory seta, 1 peg, trichoboth; tibia II, 8 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 10 tactiles, 1 attenuate sensory seta; tibia IV, 9 tactiles, trichoboth; tarsus I, 14 plumose ventrals arranged in two rows, 6 lateral and 2 dorsal tactile setae, 1 attenuate and 3 blunt sensory setae, 1 peg, dorsal terminals, solid, plumose; tarsus II, ventrals, laterals, and dorsoterminals as in tarsus I, 1 dorsal tactile seta, 1 attenuate and 2 blunt sensory setae, 1 peg; tarsus III, ventrals, laterals, and dorsoterminals as in tarsus I, trichoboth; tarsus IV, ventrals and laterals as in tarsus I, trichoboth, *dt 1* reduced to 1 solid, plumose seta, *dt 2, 3* solid, plumose.

Male: Identical to female; slightly longer than female; amphioid sclerites with 3, 1, 3, 2 setae each.

Holotype: Female, near Oakland, California (in hills), February 12, 1956, N. A. Walker, redwood.

Allotype: Male, Naperville, Illinois, January 24, 1931, C. C. Compton, in mushrooms.

Paratypes: Two females, same data as holotype.

Location of types: Holotype and paratypes deposited in the Snow Entomological Museum; the allotype deposited at the United States National Museum.

Remarks: Other than slight size differences, the only notable variation occurs in one female, which has ten pairs of setae on the genital plates, rather than seven pairs. This species is named *iota* to denote its small size when compared to the other described species of *Odontoscirus*. Drawings of the holotype.

Odontoscirus alpinus, sp. nov.

(Figs. 15, 43, 85, 86)

This species is closely related to *O. virgulatus* (Canestrini and Fanzago), 1876, but has three to four teeth on the movable digit of the chelicera instead of four to five teeth. Also, the palpal tibiotarsus of *alpinus* has two setae on the proximal half, whereas *virgulatus* has all of the setae restricted to the distal half of that segment.

Female: Color in life red with dark blue to black blotches. Body ovoid, weakly constricted; length, including gnathosoma, 1990 μ. *Gnathosoma:* Length, 533 μ; palpus (fig. 43) with tibiotarsus extending beyond hypostome; measurements: I, 12 μ; II, 189 μ; III, 26 μ; IV, 24 μ; V, 164 μ; *des,* 238 μ; *ves,* 238 μ. Chelicera normal, reticulated, 476 μ in length; digits equal in length, movable digit with 4-5 teeth, fixed digit with 1 subapical tooth; setae inserted medially (fig. 15). Gnathosomal base striated, buccal cone nonstriated; ventral setae in two longitudinal series, *vh 1-4* equidistant, interval between *vh 4-5* approximately twice the distance between *vh 2* and *3, vh 6* near the termination of buccal cone, *vh 2-4* inserted on the proximal half of the cone, *vh 1* on base; dorsal hypostomals equal in length to *vh 3. Dorsal propodosoma:* Striae finely broken; pattern similar to that of *Odontoscirus iota* (fig. 154); median propodosomals nude, approximately 100 μ in length; eyes separated by distance equal to four times the diameter of the anterior pair; distance between anterior sensilla, 78 μ. *Dorsal hysterosoma:* Setae finely plumose; length of internal humeral, 104 μ, approximately one third of first interspace; external humeral, 109 μ in length; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; one pair of anal setae; paranals wanting; postanals flanking termination of cleft, shorter than clunal setae. *Genital region:* Each genital plate with 7 equal attenuate setae in linear arrangement; 3 pairs of paragenitals; genital discs of medium size, proximate, in central area of vestibule; ovipositor with 16 subapical, 6 postmedial setae. *Legs* (figs. 85, 86): Claws with 6 lateral rays each, minute rays wanting; measurements: tibia I, 158 μ; tarsus I, 311 μ; tibia II, 151 μ; tarsus II, 298 μ. Chaetotaxy: coxae I-IV, 5, 3, 4, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 11, 13, 9, 3 tactile setae; telofemora I-IV, 7, 8, 7, 7 tactile setae; genu I, 6 tactiles, 6 attenuate sensory setae; genua II-IV, 6 tactile and 3 attenuate and two blunt sensory setae, 1 peg, *dt 1,* solid, nude,

setae, 1 peg, trichoboth; tibia II, 10 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 12 tactiles, 1 attenuate sensory seta; tibia IV, 13 tactiles, trichoboth; tarsus I, 22 plumose ventrals arranged in two rows, 10 lateral and 1 dorsal tactile seta, two attenuate and two blunt sensory setae, 1 peg, *dt 1*, solid, nude, *dt 2, 3* solid, plumose; tarsus II similar to tarsus I except lacking 1 lateral tactile seta and 1 attenuate sensory seta; tarsus III, 22 plumose ventrals, 9 laterals, dorsoterminals as in leg I, trichoboth; tarsus IV, similar to tarsus III, but *dt 1* reduced to 1 solid, nude seta.

Male: Unknown.

Holotype: Female, Piegan Pass, Glacier National Park, Montana, August 23, 1953, collector: Levi, altitude 7,900 ft.

Paratype: One female, same data as holotype.

Location of types: The holotype and paratype deposited in the Snow Entomological Museum.

Remarks: These specimens agree in general size with *O. virgulatus,* but the critical features for determination are lacking in the description of the European species. The paratype female is slightly smaller than the holotype, total length, 1030 μ, but the other features are constant. This new species is named *alpinus* because the only known specimens were collected at high altitudes. Drawings of the holotype.

Genus *Neomolgus* Oudemans

Neomolgus Oudemans, 1937, Kritisch Historisch Overzicht der Acarologie, Leiden, vol. 3, part C, p. 1229. (Type: *Acarus littoralis* L., 1758 [by original designation].)

Molgus Trouessart, 1894 (*non* Dujardin 1842, Murray 1877, Halacaridae) Jour. Ant. Physiol., vol. 30, p. 117. (Type: *Molgus sanguincus* Trouessart, 1894 [= *Acarus littoralis* L.] [by original designation].)

Molgus (*Hoplomolgus*) Berlese, 1923, Redia, vol. 15, p. 237 (new synonym). (Type: *Bdella capillata* Berlese, 1891 [*non* Kramer, 1881] [by original designation].)

This genus, which is related to *Bdellodes,* is characterized as having more than two setae on each chelicera. The chelicerae are normal; the movable digits are smooth or flattened distally on the inner surface, and are slightly longer than the fixed digits. The lateral propodosomal setae are wanting. The posterior pseudostigmata are unmodified and the posterior sensilla are longer than the median propodosomal setae. Legs II are shorter than legs I.

The subgenus *Hoplomolgus* was erected for species of *Neomolgus* (= *Molgus*) with distinct, reniform dorsal shields. These shields, formed by a large amount of cuticular deposition, are considered to be extreme modifications of a continuous character, *i. e.,* cuticular deposition.

KEY TO THE SPECIES OF NEOMOLGUS

1. Chelicera with 9-10 setae; palpal basifemur with 6-8 setae
littoralis p. 390
Chelicera with 6-8 setae; palpal basifemur with 3-4 setae
mutabilis p. 392

Neomolgus littoralis (L.)

(Figs. 29, 56, 107, 108)

Acarus littoralis Linnaeus, 1758, Syst. Nat., ed. 10, p. 618.

This species appears to be closely related to *N. capillatus* (Kramer), 1881. Although of comparable size, *N. littoralis* has fifteen to twenty-four setae on the palpal tibiotarsus rather than nine to eleven, and has long rather than short dorsal hysterosomal setae.

Female: Color in life dark red with irregular dark blue blotches. Body robust, weakly constricted; length, including gnathosoma, 2200 μ (2060-2345 μ). *Gnathosoma:* Length, 575 μ (518-660 μ); palpus (fig. 56) with genu two times longer than telofemur; measurements: I, 31 μ (29-34 μ); II, 422 μ (315-476 μ); III, 94 μ (65-119 μ); IV, 168 μ (122-185 μ); V, 400 μ (325-425 μ); *des,* 170 μ 146-170 μ); *ves,* 153 μ (119-158 μ). Chelicera (fig. 29) normal, nonstriated, 568 μ (511-617 μ) in length, with 10 (9-10) setae; movable digit with inner surface flattened apically, fixed digit extending to proximal termination of flattened surface of movable digit. Gnathosomal base striated, buccal cone nonstriated; ventral setae form two longitudinal rows, *vh 1-5* on proximal third of cone, *vh 6* medial between apex and *vh 5;* dorsal hypostomal setae as long as *vh 1. Dorsal propodosoma:* Striae finely broken; pattern similar to fig. 163, median propodosomals nude (to finely plumose), 235 μ (212-272 μ) in length; eyes separated by distance equal to 3 diameters of anterior pair, interval between eyes with transverse striae; distance between anterior sensilla, 119 μ (103-122 μ). *Dorsal hysterosoma:* Setae finely plumose; length of internal humeral, 174 μ (141-174 μ), approximately half of first interspace; external humeral, 243 μ (170-280 μ) in length; sacrals in gently curving transverse row, clunals in strongly curving transverse row. *Anal region:* Border striae parallel; anal setae wanting; three pairs of paranals; postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 12, approximately equal, attenuate setae in irregular linear arrangement; 7 paragenitals, anterior pair at level of anterior termination of aperture; genital discs large, anterior pair exceeding twice the length of the median pair; ovipositor with 20 subapical setae. *Legs* (figs. 107, 108): Claws with 7-8 lateral rays each; measurements: tibia I, 247 μ

(192-272 μ); tarsus I, 388 μ (308-425 μ); tibia II, 244 μ (187-260 μ); tarsus II, 383 μ (306-418 μ). Chaetotaxy: coxae I-IV, 11 (8-12), 11 (9-11), 13 (12), 12 (7-12) tactile setae; trochanters I-IV, 2, 2, 3 (2), 3 (4) tactile setae; basifemora I-IV, 13 (12-18), 13 (13-16), 11 (10), 8 (9) tactile setae; telofemora I-IV, 7 (7-11), 7 (8), 7 (8), 6 (7) tactile setae; genu I, 6 (6-9) tactile setae, 14 (9-14) attenuate sensory setae; genu II, 6 (6-8) tactile setae, 10 (5-11) attenuate sensory setae; genu III, 6 (5-7) tactile setae, 8 (5-8) attenuate sensory setae; genu IV, 8 (9) tactile setae, 5 (3-5) attenuate sensory setae; tibia I, 12 (11 18) tactile setae, 20 (13-23) attenuate sensory setae, 1 peg, trichoboth; tibia II, 12 (10-16) tactile setae, 13 (10-20) attenuate sensory setae, 1 blunt sensory seta, trichoboth; tibia III, 14 (14-16) tactile setae, 7 (4-9) attenuate sensory setae; tibia IV, 13 (13-14) tactile setae, 3 (1-4) attenuate sensory setae, trichoboth (may be absent); tarsus I, 28 (27-34) ventrals, distal pairs plumose, arranged in 4 rows, proximal pairs nude, in 2 rows, 10 (13) lateral, 2 dorsolateral and 2 dorsal tactile setae, 7 (5-7) attenuate sensory setae and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, coarsely plumose; tarsus II, identical to leg I, except lacking 1 dorsolateral tactile seta, *dt 2,* solid, nude; tarsus III, ventrals and laterals as in leg I, 3 attenuate sensory setae, trichoboth, dorsoterminals as in leg II; tarsus IV, similar to leg III, except 2 attenuate sensory setae, *dt 1* reduced to one seta.

Male: Identical to female; amphioid sclerites with 3, 4, 2 setae each.

Type: Europe.

Location of type: Unknown.

Remarks: Over one hundred and fifty specimens were examined, which included collections from: Alaska, Hudson Bay area, Greenland, Iceland, Spitsbergen, Bering Island, Russian Lapland (Kola-Hafvon), Nova Zembla (Matochkin Strait), and Finland.

The specimens from Matochkin Strait, four males, are of special interest. Typical in other characteristics, each of these mites lacks the trichoboth on tibia IV, a long tactile seta is inserted at the position normally occupied by the trichoboth.

Thor (1931) reports a greater variation in size and chaetotaxy in this species than indicated in the present study. Total length varies from 1500 μ to 3500 μ and other measurements vary accordingly. The setae of the palpus may vary as follows: II, 6-8; III, 1; IV, 5-7; V, 15-24 tactile setae. The redescription and illustrations are based on a female collected at Sanders Island, Greenland, August 4, 1952, J. M. Anderson, Ex: beach.

Neomolgus mutabilis, sp. nov.
(Figs. 28, 55, 111, 112, 163)

This species is closely related to *Neomolgus pallipes* (Koch), 1879, but can be distinguished by the number of setae on the palpal basifemur and chelicera, respectively, 3-4 rather than 5-6, and 6-8 rather than 8-10.

Female: Color in life unknown. Body ovoid, weakly constricted; length, including gnathosoma, 1660 μ. *Gnathosoma:* Length, 413 μ; palpus (fig. 55) with tibiotarsus approximately equal in length to basifemur, genu equal to telofemur; measurements: I, 23 μ; II, 216 μ; III, 34 μ; IV, 44 μ; V, 235 μ; *des,* 136 μ; *ves,* 124μ. Chelicera (fig. 28) normal, nonstriated with 7 setae, 371 μ in length; movable digit distally flattened on inner surface, fixed digit extending to proximal termination of flattened surface of movable digit. Gnathosomal base striated, buccal cone nonstriated; ventral setae form two longitudinal rows, *vh 1-5* approximate, equidistant, *vh 6* medial between apex and *vh 5;* dorsal hypostomal setae equal in length to *vh 2. Dorsal propodosoma* (fig. 163): Striae finely broken; median propodosomals plumose, 65 μ in length; eyes separated by distance equal to 3 diameters of anterior pair; interval between eyes with transverse striae; distance between anterior sensilla, 65 μ. *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 43 μ, approximately one fourth of first interspace; length of external humeral, 53 μ; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel, anals wanting; one pair of paranals; postanals flanking termination of cleft, equal in length to clunals. *Genital region:* Each genital plate with 8 progressively shorter setae in linear arrangement; five pairs of paragenitals, anterior pair between coxae IV; genital discs large, equidistant, in anterior three fourths of vestibule; ovipositor with 16 subapical and 4 postmedial setae. *Legs* (figs. 111, 112): Claws each with 4-6 lateral rays, one row of minute rays reduced in number; measurements: tibia I, 136 μ; tarsus I, 197 μ; tibia II, 129 μ; tarsus II, 187 μ. Chaetotaxy: coxae I-IV, 5, 5, 5, 3 tactile setae; trochanters I-IV, each with one tactile seta; basifemora I-IV, 10, 9, 7, 4 tactile setae; telofemora I-IV, 8, 7, 6, 6 tactile setae; genu I, 6 tactiles, 12 attenuate sensory setae; genu II, 6 tactiles, 5 attenuate sensory setae; genu III, 5 tactiles, 5 attenuate sensory setae; genu IV, 6 tactiles, 4 attenuate sensory setae; tibia I, 12 tactiles, 13 attenuate sensory setae, 1 peg, trichoboth; tibia II, 12 tactiles, 5 attenuate sensory setae, 1 blunt sensory seta, trichoboth; tibia III,

11 tactiles, 3 attenuate sensory setae; tibia IV, 11 tactiles, 3 attenuate sensory setae, trichoboth; tarsus I, 15 ventrals arranged in 2 rows, distal 11 plumose, 7 lateral and 2 dorsal tactile setae, 4 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* anterior to *dt 2*, solid, nude, *dt 3* between *dt 2* solid, plumose; tarsus II, 15 ventrals, distal 11 plumose, 6 lateral and 2 dorsal tactiles, 2 blunt sensory setae, 1 peg, *dt 1, 2* solid, nude, *dt 3* solid, plumose; tarsus III, ventrals and dorsoterminals as in leg II, 6 laterals, trichoboth; tarsus IV, 14 ventrals, distal 8 plumose, 5 laterals, trichoboth, *dt 1* reduced to 1 solid nude seta, *dt 2, 3* as in leg II.

Male: Closely resembles the female except in size, number of attenuate sensory setae and dorsal tactile setae on the legs and in the genital region. Length, including gnathosoma, 1320 μ, other measurements decrease accordingly; number of attenuate sensory setae: genua I-IV, 10, 6, 5, 4; tibiae I-IV, 11, 7, 3, 4; tarsus I with 3 dorsal tactile setae; each genital plate with 7 setae; amphioid sclerites with 3, 4, 2 setae each.

Holotype: Male, 2 miles south of Galena, Cherokee Co., Kansas, April 8, 1955, Ronald B. Winslow, under board.

Allotype: Female, 2 miles south of Galena, Cherokee Co., Kansas, April 8, 1955, W. T. Atyeo, under stone.

Paratypes: Four males, same data as holotype; one male, one female, same data as allotype; one male, one female, Univ. Kansas campus, Lawrence, Douglas Co., Kansas, April 22, 1952, R. E. Beer, under rock; three males, Univ. Kansas campus, collected respectively April 4, April 6, August 26, 1955, D. S. Narayan, under rocks; one male, Spring Hill, Johnson Co., Kansas, April 7, 1956, D. S. Lang, under rock; one male, 5 miles south of Avila Camacho, Distrito Federal, Mexico, July 3, 1956, R. E. Beer, moss (Berlese funnel extraction); one male, Mt. Popocatepetl, México, Mexico, August 18, 1954, W. T. Atyeo, beating lichens on trees, alt., 13,000 feet; one male, Denison, Texas, February 19, 1938, L. D. Christenson, in soil; one male, 13 miles east of Toluca, México, Mexico, August 17, 1954, W. T. Atyeo, under rocks.

Location of types: The holotype, allotype and thirteen paratypes are deposited in the Snow Entomological Museum; one paratype deposited at each of the following: the United States National Museum, the British Museum (Natural History) and the South Australian Museum.

Remarks: The chaetotaxy of the gnathosoma, genital plates and appendages exhibit considerable variation. The Mexican specimens

have one seta on the proximal half of the palpal tibiotarsus; specimens from the United States have two to three setae in this area. Sporadically, the palpal basifemora have an extra median seta, the chelicerae have six to eight setae, and the external genital flaps have seven to nine setae. The number of attenuate sensory setae on the legs varies as follows: telofemur I, 0-2; genua I-IV, 9-13, 5-6, 3-5, 2-4; tibiae I-IV, 6-13, 4-7, 2-5, 2-4. The attenuate sensory setae on telofemur I are of interest; this is one of the few species in which special sensory setae occur on the segments proximal to the genu. Total length varies from 944 μ to 1500 μ. This species is named *mutabilis* to indicate the extreme variability. Drawings are of the holotype.

Genus *Thoribdella* Grandjean

Thoribdella Grandjean, 1938, Ann. Soc. Ent. France, vol. 107, p. 4. (Type: *Biscirus meridionalis* Thor, 1931 [by original designation].)

This genus, which is probably closely related to *Bdellodes*, is distinguished by the deep goblet-shaped posterior pseudostigmatic organs and usually by the extreme reduction of the posterior sensilla. The chelicerae are normal and each has one or two setae. The inner surfaces of the movable digits are usually flattened distally, and are usually longer than the fixed digits. The lateral propodosomal setae may be present or absent. Legs II are as long or longer than legs I.

KEY TO THE SPECIES OF THORIBDELLA

1. Posterior sensilla longer than median propodosomal setae; distal cheliceral seta long, spinelike ..... *spinosa* p. 395
   Posterior sensilla much shorter than median propodosomal setae; distal cheliceral seta not spinelike 2
2. Posterior sensilla removed from median propodosomal setae; palpal genu twice as long as palpal telofemur ..... *californica* p. 396
   Posterior sensilla approximate to median propodosomal setae; palpal genu and telofemur of approximately equal lengths 3
3. Lateral propodosomal setae present ..... *insolita* p. 398
   Lateral propodosomal setae absent 4
4. Palpal genu with four setae; palpal tibiotarsus shorter than basifemur; internal humeral as long as first interspace ..... *communis* p. 399
   Palpal genu with three setae; palpal tibiotarsus as long as or longer than basifemur; internal humeral one third to one half of first interspace 5
5. Palpal basifemur three fourths the length of the tibiotarsus; posterior sensilla thickened, truncated ..... *truncata* p. 402
   Palpal basifemur and tibiotarsus of approximately equal lengths; posterior sensilla setaceous 6

6. Palpal tibiotarsus with seven setae (including end setae) restricted to distal half; cheliceral setae approximate ..... *meridionalis* p. 404
Palpal tibiotarsus with twelve setae (including end setae) not restricted to distal half; cheliceral setae distant ..... *simplex* p. 405

Thoribdella spinosa sp. nov.

(Figs. 27, 54, 109, 110, 143)

This unique species has the distal cheliceral seta modified into a long, thickened, spinelike structure which is bifid at the base, thus forming a short basal branch. The posterior sensilla are distant from, and longer than the median propodosomal setae.

Female: Color unknown. Body ovoid, weakly constricted; length, including gnathosoma, 1000 μ. *Gnathosoma:* Length, 391 μ; palpus (fig. 54) short, distal five sixths of tibiotarsus extending beyond hypostome; measurements: I, 14 μ; II, 182 μ; III, 36 μ; IV, 49 μ; V, 150 μ; *des*, 185 μ; *ves*, 160 μ. Chelicera (fig. 27) normal, nonstriated, 306 μ in length; chela smooth; distal seta large with short basal branch, proximal seta fine, approximate. Gnathosomal base, proximal third of buccal cone striated, distal two thirds nonstriated; *vh 1* inserted between palpal articulations, *vh 1-5* equidistant, arranged in 2 longitudinal series, *vh 6*, medial to series, midway between *vh 5* and apex; dorsal hypostomal setae shorter than *vh 1*. *Dorsal propodosoma:* Striae finely broken, pattern similar to fig. 142; median propodosomals nude (fig. 143), 54 μ in length; posterior sensilla fine, 85 μ in length, distant from median propodosomals; eyes separated by distance equal to two and one half diameters of anterior pair; distance between anterior sensilla, 73 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 66 μ, approximately one half of first interspace; external humeral, 66 μ in length; sacrals in gently curving row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; 1 pair of anal setae, paranals wanting; postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 7 equal setae in linear arrangement; 2 pairs of paragenitals; anterior 2 pairs of genital discs large, proximate, posterior pair small, near caudal termination of vestibule; ovipositor with 14 subapical, 6 postmedial setae. *Legs* (figs. 109, 110): Claws with 5-6 lateral rays each, row of minute rays wanting; measurements: tibia I, 71 μ; tarsus I, 214 μ; tibia II, 73 μ; tarsus II, 216 μ. Chaetotaxy: coxae I-IV, 4, 2, 2, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 11, 8, 5, 3 tactile setae; telofemora I-IV, 6, 6, 5, 4 tactile setae; genu I, 4 tactiles, 6 attenuate sensory setae; genu II,

4 tactiles, 3 attenuate sensory setae; genu III, 3 tactiles, 1 attenuate sensory seta; genu IV, 4 tactiles, 1 attenuate sensory seta; tibia I, 7 tactiles, 3 attenuate sensory setae, trichoboth; tibia II, 7 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 7 tactiles, 1 attenuate sensory seta; tibia IV, 6 tactiles, trichoboth; tarsus I, 14 ventrals arranged in 2 rows, distal 12 plumose, 7 lateral and no dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, similar to tarsus I but lacking attenuate sensory setae; tarsus III, ventrals and dorsoterminals as in tarsus I, 2 laterals, 4 large dorsolaterals, trichoboth; tarsus IV, ventrals as in tarsus I, 4 large dorsolaterals, trichoboth, *dt 1* reduced to one solid, nude seta, *dt 2, 3* solid, plumose.

Male: Unknown.

Holotype: Female, Sierra del Rosario: El Rangel, Cuba, January, 1938, Alex Bierig, en hojarasca.

Location of type: The Snow Entomological Museum.

Remarks: The unique structure of the larger cheliceral seta and the relative positions and lengths of the posterior sensilla and median propodosomal setae, warrants the naming of this species, even though based on a single specimen. The name *spinosa* is chosen to emphasize the peculiar form of the cheliceral seta. Drawings of the holotype.

Thoribdella californica (Banks), new combination

(Figs. 25, 52, 105, 106, 144)

Bdella californica Banks, 1904, Proc. California Acad. Sci., ser. 3, vol. 3, no. 13, p. 366.

Bdella magna Ewing, 1913, J. Ent. Zool., vol. 5, p. 123 (new synonym).

This species is related to *T. simplex,* sp. nov., but has the palpal genu twice as long as the telofemur rather than the two segments of approximately equal length.

Male: Color in life red, with dark blue areas. Body ovoid, weakly constricted; length, including gnathosoma, 1880 μ. *Gnathosoma:* Length, 497 μ; palpus (fig. 52) with genu approximately twice the length of the telofemur; measurements: I, 24 μ; II, 306 μ; III, 78 μ; IV, 122 μ; V, 325 μ; *des,* 221 μ; *ves,* 146 μ. Chelicera (fig. 25) normal, nonstriated, 483 μ in length; inner face of movable digit flattened distally; setae as figured. Gnathosomal base striated, buccal cone nonstriated; *vh 1-6* in linear series, *vh 1-5* progressively more distant, *vh 6* midway between *vh 5* and base of lateral lips; dorsal hypostomal setae thickened, half the length of *vh 1. Dorsal*

propodosoma: Striae finely broken, pattern similar to fig. 142; median propodosomals (fig. 144) with almost parallel margins, 331 μ in length; posterior sensilla fine, distant from median propodosomals, 51 μ in length; eyes separated by distance equal to one and one half diameters of anterior pair; distance between anterior sensilla, 100 μ. *Dorsal hysterosoma:* Setae minutely pilose; length of internal humeral about 153 μ, approximately half of first interspace; external humerals broken, length unknown; sacrals and clunals respectively in gently and strongly curving transverse rows. *Anal region:* Border striae parallel; anal setae wanting; one pair of paranals; postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 10 unequal setae in linear arrangement, anterior 7 longer than posterior 3 setae; 3 pairs of paragenitals; genital discs of medium size, equidistant; amphioid sclerites with 3, 1, 4, 1 setae each. *Legs* (figs. 105, 106): Claws with 5-7 lateral rays each, row of minute rays wanting; measurements: tibia I, 184 μ; tarsus I, 318 μ; tibia II, 201 μ; tarsus II, 331 μ. Chaetotaxy: coxae I-IV, 4, 3, 4, 3 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 13, 13, 8, 4 tactile setae; telofemora I-IV, 8, 8, 6, 6 tactile setae; genu I, 7 tactiles, 5 attenuate sensory setae; genu II, 6 tactiles, 1 attenuate sensory seta; genua III-IV, 6 tactiles and 2 attenuate sensory setae each; tibia I, 14 tactiles, 6 attenuate sensory setae, 1 attenuate-blunt sensory seta, 1 peg, trichoboth; tibia II, 11 tactiles, 2 attenuate sensory setae, 1 blunt sensory seta, trichoboth; tibia III, 12 tactiles, 1 attenuate sensory seta; tibia IV, 12 tactiles, trichoboth; tarsus I, approximately 60 ventrals, distal two thirds plumose and arranged in 5-6 irregular rows, proximal third nude and arranged in 4 irregular rows, 9 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, approximately 50 ventrals arranged as in tarsus I, 10 lateral tactiles, 1 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, 40 ventrals, proximal half nude and arranged in 2 irregular rows, distal half plumose, in 4 irregular rows, 9 laterals, trichoboth, dorsoterminals similar to tarsus I; tarsus IV, ventrals and laterals as in tarsus III, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2, 3* solid, plumose.

Female (incomplete specimen): Similar to male; genital plates with 8 pairs of setae; ovipositor with 22 setae of indeterminable position.

Type: Claremont, Los Angeles Co., California.

Location of type: Unknown.

Remarks: Two cotypes of *Thoribdella magna* (Banks), 1913 (= *Bdella magna*), one from the United States National Museum and one from the Illinois Natural History Survey, were available for examination. As these two specimens, both females, were incomplete, it is impossible to determine whether or not any differences exist between the sexes other than the number of genital setae.

This species illustrates a distinct modification of the dorsal propodosomal setae. The reduced posterior sensilla are inserted in simple, straight-sided cups, and are distant from the long, almost parallel-margined median propodosomals. Drawings and redescription are based on a male collected at Oakland, Alameda Co., California, January 30, 1953, W. C. Bentinck, habitat unknown.

Thoribdella insolita, sp. nov.

(Figs. 26, 53, 99, 100, 148)

This unique species has four pairs of dorsal propodosomal setae and seven pairs of ventral hypostomal setae. Although reminiscent of *Octobdellodes* species, *insolita* has the posterior sensilla modified to structures typical of the genus *Thoribdella*. At the present time, the lateral propodosomal setae are sufficient to distinguish this new species.

Female: Color in life unknown. Length, including gnathosoma, 1540 μ. *Gnathosoma:* Length, 468 μ; palpus (fig. 53) short, only half of the tibiotarsus extending beyond gnathosoma; measurements: I, 25 μ; II, 209 μ; III, 46 μ; IV, 53 μ; V, 190 μ; *des*, 277 μ; *ves*, 216 μ. Chelicera (fig. 26) normal, nonstriated, 442 μ in length; movable digit with inner surface distally flattened; fixed digit with preapical tooth, setae as figured. Gnathosoma striated to level of *vh 6*, distally nonstriated; *vh 1-6* approximately equidistant, in 2 longitudinal series; dorsal hypostomals about half the length of *vh 1*. *Dorsal propodosoma:* Striae finely broken, pattern similar to fig. 142, except a pair of lateral propodosomal setae inserted anterad of posterior sensilla, approximately one fourth the interval between posterior sensilla and anterior sensilla; lateral propodosomals nude, 146 μ in length; median propodosomals (fig. 148) with basal flange, 442 μ in length; posterior sensilla approximate to median propodosomals, 36 μ in length; eyes separated by distance equal to one and one half diameters of anterior pair; distance between anterior sensilla, 91 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral approximately 187 μ, slightly longer than first interspace; external humeral, 206 μ in length; sacrals and clunals respectively,

in gently and strongly curving transverse rows. *Anal region:* Border striae parallel; anal setae and postanals wanting; 2 pairs of paranals. *Genital region:* Each genital plate wtih 6 equal, long setae in linear arrangement; 3 pairs of paragenital setae; genital discs small, caudal pair near termination of vestibule, distant from anterior pairs; ovipositor with 20 setae of indeterminable position. *Legs* (figs. 99, 100): Claws with 5 lateral rays each, row of minute rays wanting; measurements: tibia I, 119 μ; tarsus I, 349 μ; tibia II, 129 μ; tarsus II, 349 μ. Chaetotaxy: coxae I-IV, 3, 2, 3, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 12, 11, 9, 2 tactile setae; telofemora I-IV, 5, 5, 4, 4 tactile setae; genu I, 4 tactiles, 3 attenuate sensory setae; genu II, 4 tactiles, 1 attenuate sensory seta; genu III, 4 tactiles, 1 attenuate sensory seta; genu IV, 4 tactiles; tibia I, 8 tactiles, 3 attenuate sensory setae, trichoboth; tibia II, 8 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 8 tactiles, 1 attenuate sensory seta; tibia IV, 12 tactiles, trichoboth; tarsus I, 20 ventral setae arranged in 2 rows, distal 15 plumose, 10 lateral and 2 dorsal tactile setae, 1 attenuate and 2 blunt sensory setae, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, 18 ventrals, 10 laterals, 1 dorsal tactile seta, 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, 17 ventrals, 9 laterals, trichoboth, 1 long, attenuate peg distal to trichoboth; dorsoterminals as in tarsus I; tarsus IV, 20 ventrals, 2 lateral and 4 long, dorsolateral tactile setae, trichoboth, *dt 1* reduced to one solid, nude seta, *dt 2, 3* solid, plumose.

Male: Unknown.

Holotype: Female, 2 miles west of Oakville, Napa Co., California, December 31, 1953, G. A. Marsh, V. D. Roth, R. O. Schuster, "Laurel association."

Location of type: The Snow Entomological Museum.

Remarks: The posterior sensilla are reduced as in other *Thoribdella* species, but lateral propodosomal setae are present. In known species of the Odontoscirinae, only *Octobdellodes* species and this new *Thoribdella* species are characterized as having the lateral propodosomal setae present. Due to the unusual presence of these setae, this new species is called *insolita.* Drawings of the holotype.

Thoribdella communis, sp. nov.

(Figs. 22, 48, 97, 98, 146)

This species appears to be related to *T. truncata*, sp. nov., but the internal humerals are as long as the first interspaces and the palpal

basifemur is longer than the tibiotarsus. In *T. truncata* the internal humerals are about one third of the first interspaces and the palpal basifemur is three fourths the length of the tibiotarsus.

Female: Color in life dark red. Body robust, ovoid, weakly constricted; length, including gnathosoma, 1730 μ. *Gnathosoma*: Length, 775 μ; palpus (fig. 48) with basifemur longer than tibiotarsus; measurements: I, 27 μ; II, 265 μ; III, 44 μ; IV, 51 μ; V, 221 μ; *des*, 267 μ; *ves*, 197 μ. Chelicera (fig. 22) normal, nonstriated, 447 μ in length; movable digit with inner surface apically flattened, fixed digit with small subapical tooth, setae as figured. Gnathosomal base striated, buccal cone nonstriated, punctate; ventral setae forming two longitudinal series, *vh 1-5* equidistant on proximal one third of cone, *vh 6* premedial between apex and *vh 5;* dorsal hypostomal setae approximately equal in length to *vh 3*. *Dorsal propodosoma:* Striae finely broken; pattern similar to fig. 142; posterior sensilla approximate to base of median propodosomals, 36 μ in length; enlarged bases of median propodosomals pilose (fig. 146); length of median propodosomals approximately 364 μ; eyes separated by a distance equal to 3 diameters of anterior pair; distance between anterior sensilla, 87 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 170 μ, approximately three fourths of first interspace; external humeral about 175 μ in length; sacrals in gently curving transverse row, external clunals absent. *Anal region:* Border striae parallel; 2 pairs of anals, 1 pair of paranals; postanals wanting. *Genital region:* Each genital plate with 7 equal genital setae in linear arrangement; three pairs of paragenitals; genital discs small, equidistant, in central area of vestibule walls; ovipositor with 16 subapical, 4 postmedial setae. *Legs* (figs. 97, 98): Claws with 6-7 lateral rays each, row of minute rays wanting; measurements: tibia I, 136 μ; tarsus I, 359 μ; tibia II, 138 μ; tarsus II, 369 μ. Chaetotaxy: coxae I-IV, 4, 3, 4, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 13, 12, 8, 4 tactile setae; telofemora I-IV, 8, 8, 7, 6 tactile setae; genu I, 6 tactiles, 5 attenuate sensory setae; genu II, 5 tactiles, 4 attenuate sensory setae; genu III, 5 tactiles, 2 attenuate sensory setae; genu IV, 5 tactiles, 2 attenuate sensory setae; tibia I, 10 tactiles, 3 attenuate sensory setae, 1 peg, trichoboth; tibia II, 10 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 11 tactiles, 1 attenuate sensory seta; tibia IV, 12 tactiles, trichoboth; tarsus I, 22 plumose ventrals arranged in 2 rows, 10 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid,

nude, *dt 2, 3* solid, plumose; tarsus II, 21 ventrals as in tarsus I, 10 lateral tactiles, 1 dorsal tactile, 1 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsi III-IV, 21 ventrals as in tarsus I, 8 laterals, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2, 3* solid, plumose on tarsus IV.

Male: Identical to female except larger; length, including gnathosoma, 1560 μ; amphioid sclerites with 3, 4, 2 setae each.

Holotype: Male, west slope of Cortez Pass, México, Mexico, August 11, 1954, W. T. Atyeo, under rock, altitude 13,000 feet.

Allotype: Female, west slope of Cortez Pass, México, Mexico, August 11, 1954, W. T. Atyeo, moss (Berlese funnel extraction).

Paratypes: Two males, four females, same data as holotype; five males, twelve females, 4 miles west of San Cristobal de las Casas, México, Mexico, July 11, 1955, R. E. Beer, under rocks; two males, 5 miles south of Avila Camacho, Distrito Federal, Mexico, July 3, 1956, R. E. Beer, on bunch grass, *Epicamees* sp.; one male, 16 miles north of Juchitan, Oaxaca, Mexico, July 4, 1955, R. E. Beer, under rock; one female, 7 miles north of Cuernavaca, Morelos, Meixco, August 14, 1954, W. T. Atyeo, beating lichens, altitude 9,000 ft.; one female, twenty miles west of México (city), Mexico, July 31, 1954, W. T. Atyeo, under rock, altitude 9,000 ft.; one female, 7 miles northeast of Jacala, Hidalgo, Mexico, July 27, 1954, W. T. Atyeo, under log.

Location of types: The holotype, allotype, and twenty-three paratypes deposited in the Snow Entomological Museum. Two paratypes deposited in each of the following: the South Australian Museum, the British Museum (Natural History), and the United States National Museum.

Remarks: The total length of the majority of the specimens is between 1350 μ to 1700 μ, however, one female from the San Cristobal series measures about 2200 μ. Other measurements of the larger specimens are proportional to total length, for example, the palpal measurements of the extremely large female are: I, 30 μ; II, 337 μ; III, 63 μ; IV, 66 μ; V, 267 μ; *des*, 315 μ; *ves*, 255 μ.

The number of setae on the palpal basifemur varies from six to nine, and on the tibiotarsus, two specimens of the paratype series have a fourth seta in the median proximal row. Variations in the number of tactile setae on the leg segments are slight, and there may be five or six attenuate sensory setae on genu I. Individuals of this species are abundant in Mexico, hence the name of *communis*. Drawings of the holotype.

Thoribdella truncata, sp. nov.

(Figs. 24, 50, 101, 102, 149, 150)

This species is related to *T. communis*, sp. nov., but has highly modified posterior sensilla (fig. 150) and internal humerals one third the length of the first interspaces, rather than small, setaceous sensilla and internal humerals equal to the first interspaces.

Female: Color in life unknown; body ovoid, weakly constricted; length, including gnathosoma, 1560 μ. *Gnathosoma:* Length, 384 μ; palpus (fig. 50) with basifemur shorter than tibiotarsus; measurements: I, 17 μ; II, 153 μ; III, 53 μ; IV, 53 μ; V, 182 μ; *des*, 122 μ; *ves* 97 μ. Chelicera (fig. 24) normal, nonstriated, 333 μ in length; movable digit with inner surface distally flattened; setae as figured. Gnathosomal base and proximal third of buccal cone striated; distal two thirds of cone nonstriated; *vh 1-6* in two longitudinal series, *vh 1* inserted between palpal articulations, *vh 1-5* equidistant, *vh 6* approximately median between *vh 5* and apex; dorsal hypostomal setae half the length of *vh 1*. *Dorsal propodosoma:* Striae finely broken; pattern similar to fig. 142; median propodosomals (fig. 149), 289 μ in length; posterior sensilla, 12 μ in length, modified as in fig. 150; eyes separated by distance equal to two diameters of anterior pair; distance between anterior sensilla, 83 μ. *Dorsal hysterosoma*: Setae finely pilose; length of internal humeral, 65 μ, approximately one third of first interspace; external humeral, 65 μ in length; sacrals and clunals respectively in gently and strongly curving transverse rows. *Anal region:* Border striae parallel; one pair of anal setae; paranals wanting; postanals flanking termination of cleft, shorter than clunal setae. *Genital region:* Eight small, unequal setae in linear arrangement, anterior 3 longer than posterior 5, two pairs of paragenitals; genital discs small, equidistant; ovipositor with 16 subapical, 4 postmedial setae. *Legs* (figs. 101, 102): Claws with 6-7 lateral rays, one row of minute rays each; measurements: tibia I, 121 μ; tarsus I, 289 μ; tibia II, 122 μ; tarsus II, 291 μ. Chaetotaxy: coxae I-IV, 4, 4, 5, 4 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 17, 13, 10, 6 tactile setae; telofemora I-IV, 8, 7, 6, 5 tactile setae; genu I, 5 tactiles, 7 attenuate sensory setae; genu II, 6 tactiles, 6 attenuate sensory setae; genu III, 5 tactiles, 5 attenuate sensory setae; genu IV, 6 tactiles, 3 attenuate sensory setae; tibia I, 12 tactiles, 5 attenuate sensory setae, 1 blunt sensory seta, 1 apically forked peg, trichoboth; tibia II,

12 tactiles, 3 attenuate sensory setae, 1 blunt sensory seta, trichoboth; tibia III, 13 tactiles, 6 attenuate sensory setae; tibia IV, 14 tactiles, trichoboth; tarsus I, 36 plumose ventrals arranged in 2 rows proximally, to five irregular series distally, 15 lateral and 2 dorsal tactiles, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1*, solid, nude, *dt 2, 3* solid, plumose; tarsus II, 36 ventrals as in tarsus I, 12 lateral and 2 dorsal tactiles, 1 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, ventrals, laterals, dorsoterminals as in tarsus I, trichoboth; tarsus IV, ventrals, laterals, *dt 2, 3* as in tarsus I, trichoboth, *dt 1* reduced to 1 solid, nude seta.

Male: Identical to female except in general size; total length, including gnathosoma, 1350 μ, other measurements vary accordingly; amphioid sclerites with 3, 1, 3, 2 setae each.

Holotype: Male, 38 miles northeast of Montemorelos, Nuevo Leon, Mexico, August 4, 1955, R. E. Beer, under rock.

Allotype: Female, same data as holotype.

Paratypes: One male, same data as holotype; two females, 3 miles west of Antiguo Morelos, Tamaulipas, Mexico, R. E. Beer, August 3, 1955, under rocks; one male, Teziutlan, Pueblo, Mexico, July 22, 1955, R. E. Beer, hand picked from litter on forest floor; one female, Vera Blanca, Costa Rica, entre los volcanes Poás y Barba, altitude 2,000 m. s. m., August, 1938, Alex Bierig.

Location of types: The Snow Entomological Museum.

Remarks: In the Mexican series, the only notable variation is the number of attenuate sensory setae on tibia II. The specimens from Montemorelos and one from Antiguo Morelos have three attenuate sensory setae on tibia II of one side of the body and two setae on the other side; in the other specimens, the number of setae is the same on both sides, either two or three.

The Costa Rican specimen is larger than the Mexican specimens, measuring 1880 μ in total length. This specimen has a simple peg and nine attenuate sensory setae on tibia I, rather than a bifurcate peg and five attenuate sensory setae. Other segments of the legs also have an increased number of setae, while the genital plates have nine pairs of setae, instead of eight.

To indicate the unique modification of the posterior sensilla, this species is named *truncata*. Drawings of the holotype.

Thoribdella meridionalis (Thor)

(Figs. 21, 51, 95, 96, 145)

Biscirus (*Biscirus*) *meridionalis* Thor, 1931, Zool. Anz., vol. 92, no. ½, pp. 74-76.

This species is closely related to *Thoribdella norvegicus* (Thor), 1913 (= *Biscirus* (*B.*) *norvegicus*), but is much smaller, as indicated by the palpal measurements given for *norvegicus* (Thor, 1931): I, 25 μ; II, 460 μ; III, 88 μ; IV, 136 μ; V, 33 μ. The relative lengths of the palpal telofemur and genu may be used to differentiate these species, *T. meridionalis* having the segments approximately equal, and *norvegicus* with the fourth segment almost twice as long as the third.

Female: Color unknown; length, including gnathosoma, 866 μ (852-1143 μ). *Gnathosoma:* Length, 218 μ (218-277 μ); palpus (fig. 51) short, about half of tibiotarsus extending beyond hypostome; measurements: I, 12 μ (12-15 μ); II, 94 μ (94-129 μ); III, 22 μ (20-26 μ); IV, 24 μ (24-31 μ); V, 78 μ (71-109 μ); *des,* 107 μ (107-129 μ); *ves,* 97 μ (94-117 μ). Chelicera (fig. 21) normal, nonstriated, 204 μ (201-247 μ) in length; movable digit flattened distally on inner surface; setae as figured. Gnathosomal base striated, buccal cone nonstriated; *vh 1-5* equidistant, in 2 longitudinal series on proximal third of cone, *vh 6* mesad to series, midway between *vh 5* and apex of cone; dorsal hypostomal setae half the length of *vh 2*. *Dorsal propodosoma:* Striae finely broken, pattern similar to fig. 142; median propodosomals (fig. 145) enlarged basally, 162 μ (158-184 μ) in length; posterior sensilla thin, approximate to medial propodosomals, 17 μ (15-17 μ) in length; eyes separated by distance equal to two and one-half diameters of anterior pair; distance between anterior sensilla, 53 μ (44-53 μ). *Dorsal hysterosoma:* Setae nude; length of internal humeral, 63 μ (51-68 μ), approximately one half of first interspace; external humeral, 66 μ (53-68 μ) in length; sacrals and clunals respectively in gently and strongly curving transverse rows. *Anal region:* Border striae parallel, anals wanting, 1 pair of paranals, postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 5 (5-7) small, equal setae in linear arrangement; 3 pairs of paragenitals; ovipositor with 16 subapical, 4 postmedial setae. *Legs* (fig. 96): Claws with 4-5 lateral rays each, row of minute rays wanting; measurements: tibia I, 53 μ (53-65 μ); tarsus I, 136 μ (136-179 μ); tibia II, 53 μ (53-66 μ); tarsus II, 134 μ (134-170 μ). Chaetotaxy: coxae I-IV, 4, 2, 3, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 9, 7, 5, 3 tac-

tile setae; telofemora I-IV, 5, 5, 4, 4 tactile setae; genu I, 4 tactiles, 5 (6) attenuate sensory setae; genu II, 4 tactiles, 3 attenuate sensory setae; genu III, 4 tactiles, 2 (3) attenuate sensory setae; genu IV, 4 tactiles, 3 attenuate sensory setae; tibia I, 7 tactiles, 3 attenuate sensory setae, 1 peg, trichoboth; tibia II, 6 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 7 tactiles, 1 attenuate sensory seta; tibia IV, 7 tactiles, trichoboth; tarsus I, 12 plumose ventrals in 2 rows, 6 lateral and 1 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2*, 3 solid, plumose; tarsus II, similar to tarsus I but lacking the 2 attenuate sensory setae; tarsus III, 13 plumose ventrals, 5 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 15 ventrals, 4 laterals, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2*, 3 solid, plumose. Male: Not examined.

Type: Male, near Tange, North Africa, January, 1931, F. Grandjean, vegetable debris under bush.

Location of type: Unknown.

Remarks: The redescription is based on thirteen females collected in the United States (Maryland, Connecticut, Kansas, Michigan, California), Iceland, Sweden (Västerbotten), and Germany (Ost-Holstein). The specimens from Germany have an extra seta on the palpal tibiotarsus, but other than this exception, all the specimens coincide with the redescription. Illustrations were prepared from a female with the following data: Patuxent Wildlife Refuge, Maryland, R. O. Drummond, February 23, 1955, *Peromyscus leucopus noveboracensis* nest, no. 27.

Thoribdella simplex, sp. nov.

(Figs. 8, 23, 49, 103, 104, 147)

The approximately equal lengths of the palpal telofemur and genu distinguish this species from the related *T. californica*, in which the genu is twice as long as the telofemur.

Female: Color unknown. Body ovoid, weakly constricted; length, including gnathosoma, 2100 μ. *Gnathosoma:* Length, 572 μ; palpus (fig. 49) with tibiotarsus extending beyond hypostome; measurements: I, 31 μ; II, 289 μ; III, 68 μ; IV, 88 μ; V, 292 μ; *des*, 218 μ; *ves*, 167 μ. Chelicera (figs. 8, 23) normal, nonstriated, 568 μ in length; inner surface of movable digit flattened distally; setae as figured. Gnathosomal base and buccal cone to level of *vh 3* striated, distal portion of cone nonstriated; *vh 1-6* in 2 longitudinal series, *vh 1*, 2 between palpal articulations, *vh 1-4* equidistant, *vh*

5 slightly removed distally, *vh 6* medial between *vh 5* and apex; dorsal hypostomal setae longer than any member of *vh* series. *Dorsal propodosoma:* Striae finely broken, pattern similar to fig. 142; median propodosomal basally expanded (fig. 147), 349 μ in length; posterior sensilla thin, 36 μ in length, approximate to median propodosomals; eyes separated by distance equal to two diameters of anterior pair; distance between anterior sensilla, 104 μ. *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 85 μ, approximately one third of first interspace; external humeral, 94 μ in length; sacrals and clunals respectively in gently and strongly curving transverse rows. *Anal region:* Border striae parallel; anal setae wanting; one pair of paranals; postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 9 unequal setae in linear arrangement, anterior 3 slightly larger than posterior 6 setae; 3 pairs of paragenitals; genital discs equidistant, anterior 2 pairs large, posterior pair small; ovipositor with 16 subapical, 4 postmedial setae. *Legs* (figs. 103, 104): Claws with 6-7 lateral rays each, row of minute rays wanting; measurements: tibia I, 218 μ; tarsus I, 394 μ; tibia II, 227 μ; tarsus II, 404 μ. Chaetotaxy: coxae I-IV, 4, 3, 4, 3 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 16, 15, 12, 5 tactile setae; telofemora I-IV, 11, 10, 10, 6 tactile setae; genu I, 7 tactiles, 12 attenuate sensory setae; genu II, 6 tactiles, 6 attenuate sensory setae; genua III-IV, 6 tactiles, 4 attenuate sensory setae each; tibia I, 13 tactiles, 14 attenuate sensory setae, 1 blunt sensory seta, 1 peg, trichoboth; tibia II, 14 tactiles, 6 attenuate sensory setae, 1 blunt sensory seta, trichoboth; tibia III, 13 tactiles, 1 attenuate sensory seta; tibia IV, 14 tactiles, trichoboth; tarsus I, 48 plumose ventrals arranged in 4 irregular rows, 12 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, similar to tarsus I, except lacking 1 lateral tactile seta and 2 attenuate sensory setae; tarsus III, 44 ventrals, 10 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 44 ventrals, 9 laterals, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2, 3* solid, plumose.

Male: Identical to female except in the chaetotaxy of the palpal basifemur, the number of attenuate sensory setae on legs I and II, and general size. Measurements: total length, 1605 μ; palpus: I, 25 μ; II, 224 μ; III, 43 μ; IV, 56 μ; V, 272 μ; *des*, 213 μ; *ves*, 158 μ; tibia I, 143 μ; tarsus I, 313 μ; tibia II, 146 μ; tarsus II, 322 μ; chelicera, 412 μ; gnathosoma, 433 μ; median propodosomals, 328 μ; posterior sensilla, 34 μ; distance between anterior sensilla, 77 μ. Palpal

basifemur with 5 setae; each genital plate with 10 setae; amphioid sclerites with 3, 1, 3, 1 setae each; genua I-II, 15 tactile setae, 9 attenuate sensory setae; tibiae I-II, 15 tactiles, 7 attenuate sensory setae. Tactile setae of legs slightly reduced from numbers indicated in holotype description.

Holotype: Female, Clinton, Douglas Co., Kansas, May 5, 1955, D. S. Narayan, grass (Berlese funnel extraction).

Allotype: Male, 1 mile west of Monticello, Madison Co., Florida, April 7, 1957, W. T. Atyeo, leaf litter.

Paratypes: One female, same data as holotype; four females, same data as allotype; two females, O'Leno State Park, Florida, April 6, 1957, W. T. Atyeo, leaf litter; one male, 2 females collected at Dinuba, Tulare Co., California, by Francis M. Summers as follows: one male, March 12, 1945, garden soil; one female, March 17, 1945, mulch; one female, March 26, 1945, mulch.

Location of types: Holotype, allotype, and seven paratypes deposited in the Snow Entomological Museum; one paratype at each of the following: the United States National Museum, the South Australian Museum, and the British Museum (Natural History).

Remarks: The Florida and California paratypes are approximately 1800 μ in length, slightly smaller than the holotype. In each of these specimens, there is a reduction in the number of setae; the palpal tibiotarsus has eight to nine setae, the palpal basifemur has five to six setae, and the genital plates have seven to eight setae each. The tactile setae on the leg segments (except the trochanters) and the attenuate sensory setae on the genua and the tibiae of legs I and II vary slightly from the numbers indicated in the description of the holotype. This species is named *simplex* because of the lack of striking morphological characters. Drawings of leg II, palpus, and dorsal propodosoma of the holotype; leg I drawn frm the Kansas paratype.

Genus *Octobdellodes*, gen. nov.

Type: *Octobdellodes hurdi* sp. nov.

This new genus is closely related to *Bdellodes*, but has the lateral propodosomal setae present and six or seven pairs of ventral hypostomal setae. The chelicerae are normal and each has two setae. The movable digits are smooth and longer than the fixed digits. The posterior pseudostigmatic organs are unmodified and the posterior sensilla are longer than the median propodosomal setae. Legs II are shorter than legs I.

KEY TO SPECIES OF OCTOBDELLODES

1. Palpal genu with four setae; palpal genu and telofemur approximately equal in length ..... *hurdi* p. 408
   Palpal genu with seven setae; palpal genu twice as long as the telofemur ..... *infrequens* p. 410

Octobdellodes hurdi, sp. nov.

(Figs. 18, 45, 93, 94, 152)

This species is related to *Octobdellodes infrequens*, sp. nov., but has the palpal genu and telofemur approximately equal in length, rather than the genu twice as long as the telofemur.

Female: Color in life unknown. Body narrowly ovoid, weakly constricted; length including gnathosoma, 1380 μ. *Gnathosoma:* Length, 374 μ; palpus (fig. 45) with tibiotarsus extending beyond hypostome; measurements: I, 17 μ; II, 189 μ; III, 32 μ; IV, 34 μ; V, 195 μ; *des*, 133 μ; *ves* 128 μ. Chelicera (fig. 18) normal, nonstriated, 323 μ in length; chela smooth, fixed digit shorter than movable digit; setae as figured. Gnathosomal base striated, buccal cone nonstriated; *vh 2-6* in longitudinal series, *vh 1, 2* form transverse row on striated base, *vh 3* between palpal articulations, *vh 3-5* equidistant, *vh 6* median between apices of lateral lips and *vh 5;* dorsal hypostomal setae equal in length to *vh 2*. *Dorsal propodosoma* (fig. 152): Striae finely broken; lateral propodosomals nude, 70 μ in length; median propodosomals nude, 85 μ in length; eyes subequal, interval between eyes equal to three diameters of the larger, anterior pair; distance between anterior sensilla, 68 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 68 μ, approximately one third of first interspace; external humeral, 73 μ in length; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; anal setae wanting; two pairs of paranals; postanals wanting. *Genital region:* Each genital plate with 7 small, equal setae in linear arrangement; 4 pairs of paragenitals; genital discs small, ovipositor with 14 subapical, 6 postmedial setae. *Legs* (figs. 93, 94): Claws with 4 lateral rays each, minute rays wanting; measurements: tibia I, 94 μ; tarsus I, 188 μ; tibia II, 80 μ; tarsus II, 172 μ. Chaetotaxy: coxae I-IV, 6 tactile setae each; trochanters I-IV, 1, 2, 2, 2 tactile setae; basifemora I-IV, 9, 9, 6, 3 tactile setae; telofemora I-IV, 7, 7, 6, 5 tactiles; genu I, 5 tactiles, 5 attenuate sensory setae; genua II-IV, 3 tactiles, 2 attenuate sensory setae; tibia I, 7 tactiles,

3 attenuate sensory setae, 1 peg, trichoboth; tibia II, 7 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 8 tactiles, 1 attenuate sensory seta; tibia IV, 8 tactiles, trichoboth; tarsus I, 15 plumose ventrals in two rows, 7 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 capitate peg, *dt 1* solid, nude, *dt 2*, 3 solid, plumose; tarsus II, 15 plumose ventrals, 5 lateral and 1 dorsal seta, 1 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, 15 plumose ventrals, 6 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 15 plumose ventrals, 5 laterals, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2*, 3 solid, plumose.

Male: Identical to female except in genital region; each genital plate with 8 setae; amphioid sclerites with 3, 4, 1 setae each.

Holotype: Female, Point Barrow, Alaska, July 5, 1952, P. D. Hurd, Berlese intermediate.

Allotype: Male, same data as holotype.

Paratypes: Four males and nine females collected by P. D. Hurd, at Point Barrow, Alaska, in 1952; these include: three females with same data as holotype; two males, four females, June 26, dry tundra, above frost line, top of polygon (Berlese funnel extraction); two males, one female, June 26, ring sample, frost scar on ridge; one female, July 26, ridge plot.

Location of types: The holotype, allotype, and five paratypes are deposited in the Snow Entomological Museum. Two paratypes are deposited at the following: the South Australian Museum, the British Museum (Natural History), the United States National Museum, and the University of California.

Remarks: Total size is relatively uniform, the greatest variation occurs in the numbers of setae. The holotype has six tactile setae on the left coxa IV and nine setae on the right coxa. Genital setae in the males vary from eight to nine pairs, and in the females, from seven to eight pairs. Tactile setae on the leg segments vary from two more, to two less, than the numbers indicated in the description of the holotype. The proximal seta on the medial surface of the palpal basifemur is absent in a few specimens. The species is named for Dr. P. D. Hurd of the University of California, who collected the type series of this species. Drawings are of the holotype.

Octobdellodes infrequens, sp. nov.

(Figs. 19, 20, 46, 89, 90, 153)

This species is related to *O. hurdi,* sp. nov., but can be distinguished by the palpal genu which is two times longer than the telofemur and which has seven setae rather than the genu equal in length to the telofemur and with four setae.

Female: Color in life unknown. Body large, ovoid, weakly constricted; length, including gnathosoma, 2700 μ. *Gnathosoma:* Length, 629 μ; palpus (fig. 46) long, half of the genu and tibiotarsus extending beyond hypostome; measurements: I, 30 μ; II, 357 μ; III, 68 μ; IV, 156 μ; V, 335 μ; *des,* 323 μ; *ves,* 264 μ. Chelicera normal, nonstriated, 575 μ in length; fixed digit and movable digit with preapical tooth, fixed digit slightly shorter than opposing digit; cheliceral setae inserted as in figs. 19, 20. Gnathosomal base striated, buccal cone nonstriated; *vh 1, 2* form transverse row on hypostome base, *vh 2-5, 7* form longitudinal series, *vh 6* mesad, *vh 1* laterad; *vh 2-7* approximately equidistant; dorsal hypostomal setae about half the length of *vh 1. Dorsal propodosoma* (fig. 153): Striae finely broken; lateral propodosomals nude, 158 μ in length; median propodosomals nude, 145 μ in length; eyes separated by distance equal to 2 diameters of anterior pair; distance between anterior sensilla, 68 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 146 μ, approximately half of first interspace; external humeral, 155 μ in length; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; anal setae wanting; 2 pairs paranals; postanals removed laterad of termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 9 long, equal setae in linear arrangement, 5 pairs of paragenitals; genital discs equidistant, in middle portion of vestibule; ovipositor with 16 subapical, 6 postmedical setae. *Legs* (figs. 89, 90): Claws with 6-7 lateral rays, 1 row of minute rays each; measurements: tibia I, 187 μ; tarsus I, 377 μ; tibia II, 187 μ; tarsus II, 377 μ. Chaetotaxy: coxae I-IV, 5, 5, 6, 3 tactile setae; trochanters I-IV, 1, 2, 2, 2 tactile setae; basifemora I-IV, 14, 15, 10, 5 tactile setae; telofemora I-IV, 10, 9, 9, 7 tactile setae; genu I, 6 tactile setae, 5 attenuate sensory setae; genu II, 6 tactile setae, 4 attenuate sensory setae; genua III-IV, 6 tactile setae and 3 attenuate sensory setae each; tibia I, 11 tactiles, 4 attenuate sensory setae, 1 peg, trichoboth; tibia II, 11 tactiles, 3 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 14 tactiles, 1 attenuate sensory seta; tibia IV, 13 tactiles, trichoboth; tarsus I, 32 plumose ventral

setae arranged in 2 rows on proximal third, in four rows on distal two thirds, 10 lateral and 2 dorsal tactiles, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, 32 plumose ventrals arranged as in tarsus I, 10 lateral and 2 dorsal tactiles, 1 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals as in tarsus I; tarsus III, ventrals, laterals, dorsoterminals as in tarsus II, trichoboth; tarsus IV, 36 ventrals, 8 laterals arranged as in tarsus I, trichoboth, *dt 1* reduced to 1 solid, nude seta, *dt 2, 3* solid, plumose.

Male: Identical to female except in size and chaetotaxy of the palpus. Measurements: length, including gnathosoma, 1740 μ; palpus: I, 26 μ; II, 325 μ; III, 54 μ; IV, 104 μ; V, 269 μ; *des*, 247 μ; *ves*, 207 μ; chelicera, 497 μ; gnathosoma, 476 μ; tibia I, 143 μ; tarsus I, 320 μ; tibia II, 143 μ; tarsus II, 317 μ. Setae on the dorsal propodosoma and dorsal hysterosoma only slightly shorter. Second palpal segment with 10 tactile setae, fifth segment with 12 tactile setae (excluding apical setae). Amphioid sclerites with 3, 4, 2 setae each.

Holotype: Male, Douglas County, Kansas, February 17, 1952, C. C. Hall, on shagbark hickory.

Allotype: Female, Sioux City, Iowa, October 15, 1921, C. N. Ainslie, under stone.

Paratypes: Male, Imoden, Arkansas, received at USNM January 14, 1935, from B. C. Marshall; female, Patuxent Wildlife Refuge, Maryland, January 13, 1954, R. O. Drummond, *Peromyscus leucopus noveboracensis* nest, no. 11.

Location of types: The holotype and paratypes are deposited in the Snow Entomological Museum; the allotype is deposited at the United States National Museum.

Remarks: It is difficult to estimate the amount of variation in the species because of the limited number of specimens. The allotype is an extremely large female, probably gravid, while the paratypes are comparable in size to the holotype. The number of ventral hypostomal setae in the four specimens is very variable. Five pairs of setae are always present on the buccal cone, but in the transverse row across the gnathosomal base, there may be two to three pairs, totaling therefore, seven to eight pairs of ventral hypostomal setae rather than the usual six pairs.

This species, although apparently widely distributed, has been infrequently collected, therefore the specific name of *infrequens* has been selected for this new taxon. Drawings of the holotype.

Genus *Bdellodes* Oudemans

Bdellodes Oudemans, 1937 (= *Scirus, sensu* Thor, 1931, *non* Hermann, 1804), Kritisch Historisch Overzicht der Acarologie, Leiden, vol. 3, part C, p. 1217. (Type: *Scirus longirostris* Hermann, 1804 [by original designation].)
Hoploscirus Thor, 1937, Zool. Anz., vol. 119, no. ½, p. 43 (new synonym). (Type: *Scirus dubitatus* Womersley, 1933 [by original designation].)

Bdellodes is closely related to *Octobdellodes,* gen. nov., but lacks the lateral propodosomal setae. The chelicerae are normal and each has one or two setae. The sickle-shaped movable digits are longer than the fixed digits, and may be smooth, flattened distally on the inner surfaces, or have a single tooth. The posterior pseudostigmatic organs are unmodified and the posterior sensilla are longer than the median propodosomal setae. Legs II are usually shorter than legs I.

The genus *Hoploscirus* was erected for species of *Bdellodes* (= *Scirus, sensu* Thor) with distinct, reniform dorsal shields. The differentiating character for this group is an extreme modification of cuticular deposition, which is considered to be a continuous character.

KEY TO THE SPECIES OF BDELLODES

1. Chelicera with one seta; palpal basifemur and tibiotarsus (excluding end setae) with twelve to fourteen setae each *longirostris* p. 412
   Chelicera with two setae; palpal basifemur and tibiotarsus (excluding end setae) with five to six setae each *bisetosa* p. 414

Bdellodes longirostris (Hermann)

(Figs. 14, 42, 87, 88)

Scirus longirostris Hermann, 1804, Mém. Apt. p. 62.
Bdella peregrina Banks var. *iowaensis* Ewing, 1917, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 150 (new synonym).

This species is closely related to *Bdellodes porrectus* (Kramer) 1898, but the palpal genu and telofemur are approximately equal in length and each digit of the chela has one preapical tooth, rather than the genu twice as long as the telofemur and the digits smooth.

Female: Color in life red, with dark blue flecks. Body ovoid; length, including gnathosoma, 1810 μ (1335-2270 μ). *Gnathosoma:* Length, 504 μ (447-568 μ); palpus (fig. 42) with short, subequal end setae; measurements: I, 27 μ (24-28 μ); II, 357 μ (264-408 μ); III, 61 μ (60-63 μ); IV, 70 μ (50-70 μ); V, 325 μ (243-352 μ); *des,* 218 μ (197-238 μ); *ves,* 201 μ (179-201 μ). Chelicera (fig. 14) normal, nonstriated, 471 μ (412-547 μ) in length; each digit with one preapical tooth; single seta inserted at approximately two thirds of the length of chelicera from base. Gnathosomal base striated,

buccal cone nonstriated; *vh 2-6* form 2 longitudinal series, *vh 1* laterad, between articulations of palpi; *vh 2-5* approximately equidistant, *vh 6* median between *vh 5* and termination of buccal cone; dorsal hypostomal setae approximately equal in length to *vh 3*. *Dorsal propodosoma:* Striae finely broken, pattern similar to fig. 153; median propodosomals finely plumose, 133 μ (119-163 μ) in length; eyes separated by distance equal to 2 diameters of anterior pair, interval between eyes with transverse striae; distance between anterior sensilla, 85 μ (65-88 μ). *Dorsal hysterosoma:* Setae finely plumose; length of internal humeral, 99 μ (87-109 μ), approximately half of first interspace; external humeral, 100 μ (95-128 μ) in length; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; 1 pair of anal setae; paranals wanting; postanals flanking cleft approximately one fourth length of cleft from dorsal termination, shorter than clunals. *Genital region:* Each plate with 6 (7) long, equal, attenuate setae in linear arrangement; 4 (5) pairs of paragenitals, anterior pair at level of anterior termination of aperture; genital discs small, one pair at anterior end, two pairs approximate, caudad; ovipositor with 18 subapical setae. *Legs* (figs. 87, 88): Claws with 6-7 lateral rays and one row of minute rays each; measurements: tibia I, 167 μ (126-177 μ); tarsus I, 296 μ (264-325 μ); tibia II, 167 μ (126-175 μ); tarsus II, 296 μ (264-322 μ). Chaetotaxy: coxae I-IV, 5 (4), 3, 4, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 15 (13-16), 15 (14), 13 (9-13), 6 (4-6) tactile setae; telofemora I-IV, 8 (7), 7, 6, 6 (7) tactile setae; genu I, 6 (5) tactile setae, 5 (4-6) attenuate sensory setae; genu II, 6 tactile setae, 3 (2) attenuate sensory setae; genua III-IV, 6 (5) tactile setae and 2 attenuate sensory setae each; tibia I, 13 (10-14) tactile setae, 4 (3) attenuate sensory setae, 1 peg, trichoboth; tibia II, 12 (9-12) tactile setae, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 12 (11) tactile setae, 1 attenuate sensory seta; tibia IV, 13 (10-13) tactile setae, trichoboth; tarsus I, 29 (24-32) plumose ventral setae, distal members in 4 irregular rows, proximal members in 2 rows, 11 (10) lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus II, similar to tarsus I except with 9 (7-9) laterals, 1 dorsal tactile seta, 1 attenuate sensory seta; tarsus III, ventrals and dorsoterminals as in tarsus I, 8 laterals, trichoboth; tarsus IV, ventrals as in tarsus I, 9 laterals, trichoboth, *dt 1* reduced to one solid, nude seta, *dt 2, 3* solid, plumose.

Male: Identical to female; amphioid sclerites with 3, 4, 2 setae each.

Type: Europe.

Location of type: Unknown.

Remarks: Specimens examined were collected in: Mexico (Michoacán, Jalisco, Oaxaca, Guanajuato, México, Distrito Federal, Puebla, Nuevo León, Guerrero, Tamaulipas), the United States (Texas, California, Kansas, Arkansas, Florida, Michigan, Montana), Cuba, Costa Rica, Jamaica, Argentina, and Denmark. The number of setae on the palpus may vary from ten to fifteen on the basifemur, and from twelve to fourteen on the tibiotarsus. Redescription and drawings are based on two males from: twenty miles west of Morelia, Michoacán, Mexico, July 20, 1956, R. E. Beer, under rock.

Bdellodes bisetosa, sp. nov.

(Figs. 47, 91, 92, 155)

This species is related to *B. longirostris* but may be distinguished from this species by the chaetotaxy of the palpus, having five setae on the basifemur and tibiotarsus (excluding the end setae) rather than twelve to fourteen setae on each of these segments. In addition, *bisetosa* has two setae on each chelicera rather than one.

Female: Color unknown. Body narrowly ovoid, weakly constricted; length, including gnathosoma, 1100 μ. *Gnathosoma:* Length, 277 μ; palpus (fig. 47) short, distal half of the tibiotarsus extending beyond hypostome; measurements: I, 14 μ; II, 114 μ; III, 25 μ; IV, 39 μ; V, 124 μ; *des,* 119 μ; *ves,* 102 μ. Chelicera normal, nonstriated, 255 μ in length; movable digit with inner surface flattened distally, fixed digit with preapical tooth and shorter than movable digit; setae inserted as in *Bdella longicornis.* Gnathosomal base striated, buccal cone nonstriated; *vh 1-5* equidistant, in longitudinal series, *vh 6* medial between apex and *vh 5, vh 1* inserted between palpal articulations; dorsal hypostomal setae approximately half the length of *vh 1. Dorsal propodosoma* (fig. 155): Striae finely broken; median propodosomals nude, 70 μ in length; eyes separated by distance equal to three diameters of anterior pair; distance between anterior sensilla, 60 μ. *Dorsal hysterosoma:* Setae nude, length of internal humeral, 51 μ, approximately one half of first interspace; external humeral, nude, 50 μ in length; sacrals in gently curving transverse row, clunals in subrectangular arrangement. *Anal region:* Border striae parallel; anal setae wanting; one pair of paranals; postanals flanking termination of cleft, approximately equal

in length to external clunals. *Genital region:* Each genital plate with 9 small, equal setae in linear arrangement; 3 pairs of paragenitals; genital discs small, equidistant; ovipositor with 16 subapical, 4 postmedial setae. *Legs* (figs. 91, 92): Claws with 5 to 6 lateral rays each, distally alternating with 4 short rays; measurements: tibia I, 70 μ; tarsus I, 170 μ; tibia II, 77 μ; tarsus II, 170 μ. Chaetotaxy: coxae I-IV, 6, 3, 6, 2 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 10, 10, 9, 4 tactile setae; telofemur I, 7 tactile setae, 1 attenuate sensory seta; telofemora II-IV, 7 tactile setae each; genu I, 5 tactiles, 6 attenuate sensory setae; genu II, 4 tactiles, 4 attenuate sensory setae; genu III, 5 tactiles, 3 attenuate sensory setae; genu IV, 5 tactiles, 3 attenuate sensory setae; tibia I, 8 tactiles, 3 attenuate sensory setae, 1 hollow peg, trichoboth; tibia II, 8 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia III, 10 tactiles, 1 attenuate sensory seta; tibia IV, 9 tactiles, trichoboth; tarsus I, 13 plumose ventrals arranged in 2 rows, 5 lateral and 2 dorsal tactile setae, 2 attenuate and 2 blunt sensory setae, 1 peg, dorsoterminals solid, plumose; tarsus II, 14 ventrals as in tarsus I, 5 lateral and 2 dorsal tactile setae, 2 blunt sensory setae, 1 peg, dorsoterminals solid, plumose; tibia III, ventrals, laterals, and dorsoterminals as in tarsus I, trichoboth; tarsus IV, 14 ventrals as in tarsus I, 5 laterals, trichoboth, *dt 1* reduced to 1 solid, plumose seta, *dt 2, 3* solid, plumose.

Male: Identical to female except in general size and genital region; length including gnathosoma, 995 μ; genital plates with 8 pairs of setae; amphioid sclerites with 1, 6, 1 setae each.

Holotype: Female, 10 miles west of Tuxtla Gutierrez, Chiapas, Mexico, July 8, 1955, R. E. Beer, under rock.

Allotype: Male, same data as holotype.

Paratypes: Six males and six females, same data as holotype; one male, one female, 17 miles north of Tehuitzingo, Puebla, Mexico, July 18, 1955, R. E. Beer, under rocks.

Location of types: The holotype, allotype, and eight paratypes deposited in the Snow Entomological Museum; two paratypes deposited in each of the following: the United States National Museum, the South Australian Museum, and the British Museum (Natural History).

Remarks: The number of pairs of setae on the female genital plates may be eight, nine, or eleven. When the latter number occurs, two setae are lateral to the longitudinal series. The amphioid sclerites of the male have one or two setae in the anterior

group plus six median setae and one posterior seta. Variation in general size is slight in the small type series. Because of the two setae on each chelicera, rather than the usual number of one, this new species is named *bisetosa.* Drawings of the holotype.

Cytinae Grandjean, 1938

The members of this subfamily have two pairs of conspicuous ventral hypostomal setae, maximally three pairs of trichoboths, and well developed genital tracheae. The palpal tibiotarsus is truncate and usually slightly longer than the combined length of the genu and telofemur. The subequal end setae are longer than the palpal femur. The chelicerae are thickened (*Cyta*) or normal (*Trachymolgus*) and each bears two setae, one of which is inserted at the base of the fixed digit. The dorsal propodosoma has lateral propodosomal setae, secondary apodemes well develoed, four eyes lateral to the unmodified posterior pseudostigmatic organs, and in *Cyta,* a fifth, unpaired eye between the anterior sensilla. The podocephalic canal is an internal tube in *Trachymolgus* and an external groove in *Cyta* (Grandjean, 1938). An unpaired seta occurs immediately anterior to the genital flaps (between coxae IV in *Cyta spuria,* sp. nov).

Genus *Cyta* von Heyden

Cyta v. Heyden, 1826, Isis von [Lorenz von] Oken, Leipzig (= Encyklopädische Zeitsch. vorz. Naturgesch., vergl. Anat. und Phys., vol. 19, no. 6, p. 608. (Type: *Scirus latirostris* Hermann,, 1804 [by original designation].)

Amonia Koch, 1836, Deutschlands Crustaceen, Myriapoden und Arachniden. Ein Beitrag zur Deutschen Fauna von C. L. Koch, Regensburg, fasc. 5, no. 7. (Type: *Amonia cruciata* Koch, 1836 [= *Cyta latirostris* Hermann] [first included species].)

Ammonia Koch, 1842 (*non* Bruennich, 1772, Mollusca), Übersicht des Arachnidensystems von C. L. Koch, Nürnberg, vol. 3, p. 75. (Type: *Amonia megacephala* Koch, 1839 [= *Cyta latirostris* Hermann] [by original designation].)

Troglobdella Oudemans, 1937, Kritisch Historisch Overzicht der Acarologie, Leiden, vol. 3, part C, p. 1228 (new synonym). (Type: *Scirus obisium* Gervais, 1841 [= *Cyta latirostris* Hermann] [by original designation].)

The genus *Cyta* is related to *Trachymolgus,* but is distinguished by thickened chelicerae with massive chelae, and an unpaired median eye between the anterior sensilla. The distal pair of ventral hypostomal setae are inserted immediately anterior or posterior to the suture separating the buccal cone and the strongly developed lateral lips. The posterior sensilla are widely separated and near the lateral margins of the dorsal propodosoma. Well developed lateral apodemes and weakly developed transverse apodemes are present. There may be three, one, or no pairs of trichoboths. The podocephalic canal is an external groove (Grandjean, 1938).

Troglobdella Oudemans is tentatively placed in synonymy with *Cyta*. Oudemans erected this genus for a poorly described and poorly illustrated species, *Scirus obisium* Gervais, 1841. As described by Gervais, this species lacks both trichoboths and eyes, has extremely short palpi and end setae, is light orange to translucent in color, and has the posterior pseudostigmatic organs widely separated. Except for the apparent lack of eyes, the other distinguishing features of *Scirus obisium* can be found in a proto- or deutonymph of *Cyta latirostris*. It is possible to imagine that eyes could be overlooked because of poor optical equipment or an unsatisfactory method of preparation.

Key to Cyta

1. Trichoboths on tibiae I, IV, tarsus III; lateral propodosomals not approximate to posterior sensilla 2
   Trichoboth on tibia IV; lateral propodosomals approximate to posterior sensilla ..... *latirostris* p. 417
2. Integument purple; palpal basifemur with more than six setae and extending well beyond hypostome ..... *coerulipes* p. 419
   Integument not purple; palpal basifemur with less than six setae and not extending well beyond hypostome ..... *spuria* p. 421

Cyta latirostris (Hermann)

(Figs. 30, 60, 164, 172, 178)

Scirus latirostris Hermann, 1804, Mém. Apt., p. 62.
Bdella robustirostris Ewing, 1913, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 112, plate 7, fig. 3.
Cyta novangliae Jacot, 1939, Occ. Pap. Boston Soc. Nat. Hist., vol. 8, p. 322 (not examined) (new synonym).

This species is related to *Cyta spuria*, sp. nov., but has only one pair of trichoboths inserted on tibia IV, rather than three pairs inserted on tibiae I and IV and tarsi III.

Female: Color in life dark red with dark blue-black blotches. Body short, robust; length, including gnathosoma, 925 μ (664-1100 μ). *Gnathosoma:* Length, 178 μ (160-221 μ); palpus (fig. 60) with basifemur not extending beyond hypostome; measurements: I, 17 μ (16-20 μ); II, 124 μ (107-126 μ); III, 29 μ (24-34 μ); IV, 27 μ (24-34 μ); V, 66 μ (53-68 μ); *des*, 170 μ (136-196 μ); *ves*, 131 μ (111-160 μ). Chelicera (fig. 30) inflated, thickened distally, striated, 173 μ (153-209 μ) in length; inner surface of fixed digit with 2 distal teeth; setae as figured. Gnathosoma striated; *vh 2* inserted on lateral lips, immediately anterior to articulation of lips; dorsal hypostomals longer than *vh 2*. *Dorsal propodosoma* (fig. 164): Striae finely broken; lateral propodosomals nude, approxi-

mately 54 μ (54-80 μ) in length; median propodosomals minutely pilose, 44 μ (41-71 μ) in length; eyes separated by distance equal to two and one-half diameters of anterior pair; distance between anterior sensilla, 110 μ (102-155 μ). *Dorsal hysterosoma:* Setae minutely pilose to pilose; length of internal humeral, 44 μ (36-60 μ), approximately one third to one half of first interspace; external humeral, 41 μ (37-60 μ) in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae parallel; 2 pairs of anal setae; 3 pairs of paranals; postanals wanting. *Genital region:* Each genital plate with 8 (7-9) unequal setae in irregular linear arrangement, anterior 3 setae longer than posterior 6 (5-7) setae; 6 pairs of paragenital setae, 1 unpaired median seta anterior to genital plates; genital discs small, equidistant, in central region of vestibule; ovipositor with 18 subapical, 2 postmedial setae. *Legs* (similar to figs. 113, 114): Claws with one row of minute rays each, lateral rays wanting; measurements: tibia I, 99 μ (83-119 μ); tarsus I, 124 μ (107-126 μ); tibia II, 61 μ (51-68 μ); tarsus II, 85 μ (75-112 μ). Chaetotaxy: coxae I-IV, 5, 5 (4), 4, 2 tactile setae; trochanters I-IV, 2 (1), 2, 2, 2 (3) tactile setae; basifemora I-IV, 9 (10), 8 (9), 7, 4 tactile setae; telofemora I-IV, 5 (5-7), 6 (7), 4 (4-6), 4 (4-6) tactile setae; genua I-III, 7 (6) tactile setae and 1 attenuate sensory seta each; genu IV, 6 tactile setae; tibia I, 9 (8) tactiles, 1 attenuate and 1 blunt sensory seta, 1 peg; tibia II, 9 (8) tactiles, 1 large and 1 small blunt sensory seta; tibia III, 9 (8) tactiles, 1 blunt sensory seta; tibia IV, 8 (7) tactiles, trichoboth; tarsus I, 14 (11-14) minutely pilose ventral setae arranged in 2 rows, 8 lateral and 2 dorsal tactiles, 2 (1) attenuate and 2 blunt sensory setae, 1 peg, *dt 1, 3* hollow, minutely pilose, *dt 2* solid, nude; tarsus II, 11 (11-12) ventrals, 6 lateral and 2 dorsal tactiles, 1 blunt sensory seta, 1 peg, *dt 1,* anterior *dt 3* as in tarsus I, *dt 2,* posterior *dt 3* solid, minutely pilose; tarsus III, 12 (10-13) ventrals, 6 (5) lateral and 1 dorsal tactile seta, dorsoterminals solid, minutely pilose; tarsus IV, 13 (10-13) ventrals, 1 attenuate sensory seta, *dt 1* reduced to one solid, minutely pilose seta, *dt 2, 3* as in tarsus III.

Male: Identical to female; amphioid sclerites as in fig. 172.

Type: Europe.

Location of type: Unknown.

Remarks: Approximately one hundred specimens were examined, which included material from: Cuba, Jamaica, Mexico (Puebla, México, San Luis Potosí), the United States (California, Utah, Idaho, Texas, Arkansas, Kansas, Nebraska, North Dakota, Michigan,

Alabama, Tennessee, West Virginia, Maryland, Connecticut), Alaska (Point Barrow), Iceland, Italy, Germany, and Australia.

Two specimens from Italy have three setae on the palpal genu, which agrees with Thor's (1931) description of this species, the remainder of the specimens have four setae on this segment. The number of tactile setae on the appendages varies only slightly from the numbers indicated in the above description, although there may be four to seven setae on the palpal basifemur. Special sensory setae are constant, except for the occasional absence of one attenuate sensory seta on tarsus I. Grandjean (1938) reports that *C. latirostris* in Europe is actually composed of two species; the typical species with one pair of trichoboths and another species lacking trichoboths. Only individuals of the first type were encountered in the present study. The description and illustrations are based on a female from: near Sheep Canyon, Borego State Park, San Diego Co., California, April 27, 1955, R. O. Schuster, sycamore and palm litter.

Cyta coerulipes (Dugès)

(Figs. 31, 57, 58, 115, 116, 165, 171)

Type: *Bdella coerulipes* Dugès, 1834, Ann. Sci. Nat., ser. 2, vol. 2, p. 45.

This distinctive species is related to *C. spuria,* sp. nov., but is easily distinguished by having a purple integument, the palpal basifemur extending beyond the hypostome, and external sacrals and clunals longer than the same internal members. In contrast, *C. spuria* has a neutral colored integument, the palpal basifemur is shorter than the hypostome, and the sacrals and clunals are of approximately equal lengths.

Female: Color in life dark yellow with brown blotches to deep purple. Body strongly widened at shoulders; length including gnathosoma, 860 μ (750-1100 μ). *Gnathosoma:* Length, 254 μ (214-266 μ); palpus (figs. 57, 58) with elongate basifemur extending slightly beyond hypostome; measurements: I, 19 μ (17-20 μ); II, 250 μ (179-277 μ); III, 34 μ (26-36 μ); IV, 32 μ (24-34 μ); V, 94 μ (71-95 μ); *des,* 316 μ (292-316 μ); *ves,* 240 μ (211-240 μ). Chelicera (fig. 31) thickened distally, faintly striated, 226 μ (192-238 μ) in length; fixed digit with broad tooth medially; setae as figured. Gnathosomal base and proximal two thirds of buccal cone striated; *vh 2* inserted immediately proximal to lateral lips; dorsal hypostomals approximately equal in length to adornal setae. *Dorsal propodosoma* (fig. 165): Striae sparsely broken; lateral propodosomals

plumose, 92 μ (66-111 μ) in length; median propodosomals plumose, 129 μ (111-167 μ) in length; eyes separated by distance equal to two and one half diameters of anterior pair; distance between anterior sensilla, 112 μ (85-117 μ). *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 114 μ (105-145 μ), approximately equal to first interspace; external humeral, 122 μ (85-170 μ) in length; sacrals and clunals in strongly curving transverse rows. *Anal region:* Border striae parallel; anal and postanal setae wanting; 3 (2) pairs of paranals. *Genital region:* Each genital plate with 9 unequal setae in linear arrangement, anterior 3 longer than posterior 6; 6 (7) pairs of paragenitals; unpaired median seta caudad to coxae IV; ovipositor with 18 subapical, 2 postmedial setae. *Legs* (figs. 115, 116): Claws with one row of minute rays each, lateral rays wanting; measurements: tibia I, 95 μ (78-107 μ); tarsus I, 153 μ (128-160 μ); tibia II, 83 μ (60-95 μ); tarsus II, 136 μ (119-146 μ). Chaetotaxy: coxae I-IV, 5 (4), 4 (5), 5 (6), 4 (3-5) tactile setae; trochanters I-IV, 2 tactile setae each; basifemora I-IV, 7 (8), 7 (5-8), 7 (6-8), 5 (4) tactile setae; telofemora I-IV, 5 (5-7), 5 (4-6), 4 (5), 4 (3) tactile setae; genu I, 4 (3) tactiles, 2 attenuate sensory setae; genu II, 4 (5) tactiles, 1 attenuate sensory seta; genu III, 5 (4-6) tactiles, 1 attenuate sensory seta; genu IV, 6 (5) tactiles, 1 attenuate sensory seta; tibia I, 8 (8-10) tactiles, 2 attenuate sensory setae, 1 peg, trichoboth; tibia II, 9 (8) tactiles, 1 attenuate and 1 blunt sensory seta; tibia III, 9 (8-10) tactiles, 1 attenuate sensory seta; tibia IV, 10 (9) tactiles, trichoboth; tarsus I, 12 (11-13) pilose ventrals arranged in two rows, 8 (7) lateral and 2 dorsal tactiles, 2 (1) attenuate and 2 blunt sensory setae, dorsoterminals solid, pilose; tarsus II, 10 (11) ventrals, 7 (8) lateral and 2 dorsal tactiles, 1 attenuate and 1 blunt sensory seta, dorsoterminals as in tarsus I; tarsus III, 12 ventrals, 8 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 12 (11) ventrals, 6 laterals, 1 attenuate sensory seta, tricohboth wanting, *dt 1* reduced to one solid, pilose seta, *dt 2, 3* solid, pilose.

Male: Identical to female; amphioid sclerites each with 9 (8) setae (fig. 171).

Type: Europe.

Location of type: Unknown.

Remarks: Approximately 200 slides were examined, which included specimens from: Panama, Haiti, Cuba, Mexico (San Luis Potosí, Guerrero, Tamaulipas, Hidalgo), the United States (Colorado, California, Texas), Alaska (Umiat) and Sudan Bor.

Slight, but constant variation in the widely separated localities indicates that *C. coerulipes* may be a group of closely related species or subspecies. Extreme variation is found in the forms of the palpal setae. In southeastern Texas and northeastern Mexico, the small tactile setae are strongly plumed (fig. 58), a condition not found in other geographical areas. The attenuate sensory setae on tibia I undergo considerable migration and reduction in numbers, for example, the Cuban specimens have the two approximate attenuate sensory setae near the distal margin of the segment rather than the proximal margin (fig. 115). Specimens from Panama have three sensory setae in a linear arrangement, while those from Colorado and Sudan Bor have only two attenuate sensory setae.

The striae on the dorsal propodosoma are usually almost continuous, but in the insular material, the striae are finely broken, resembling those found in *Cyta latirostris* (fig. 164).

The redescriptions and illustrations are based on a male and a female from: five miles east of Ciudad del Maiz, San Luis Potosí, Mexico, August 23, 1954, W. T. Atyeo, ground litter, altitude 4,700 feet. An illustration of plumose setae on the palpus was prepared from a male from: ten miles north of Edinburg, Texas, April 9, 1954, R. E. Beer, under rock.

Cyta spuria, sp. nov.

(Figs. 11, 59, 113, 114, 167, 173)

In size and shape, this species closely resembles *Cyta latirostris*, but may be distinguished by the presence of trichoboths on tibiae I, IV, and tarsus III rather than trichoboths only on tibia IV.

Female: Color in life unknown. Body short, robust, weakly constricted; length, including gnathosoma, 810 μ. *Gnathosoma:* Length, 194 μ; palpus (fig. 59) with basifemur-telofemur articulation indistinct; measurements: I, 14 μ; II plus III, 138 μ; IV, 22 μ; V, 61 μ; *des*, 179 μ: *ves*, 136 μ. Chelicera inflated, striated, 158 μ in length; fixed digit smooth, longer than movable digit (fig. 11); distal seta inserted above proximal limit of movable digit, proximal seta as in *C. latirostris*, except extending beyond articulation of chela. Gnathosomal base and proximal two thirds of buccal cone striated; *vh* 2 immediately proximal to lateral lips; dorsal hypostomal setae equal in length to *vh* 2. *Dorsal propodosoma* (fig. 167): Striae very finely broken; lateral propodosomals plumose, 77 μ in length; median propodosomals plumose, 78 μ in length; eyes separated by distance equal to two and one half diameters of anterior pair; distance between anterior sensilla, 97 μ. *Dorsal hysterosoma:*

Setae plumose; length of internal humeral, 73 μ, approximately three fourths of first interspace; external humeral, 77 μ in length; sacrals and clunals in strongly curving transverse rows. *Anal region:* Border striae parallel; anal and postanal setae wanting; 3 pairs of paranals. *Genital region:* Each genital plate with 9 unequal setae in linear arrangement, anterior 3 longer than posterior 6; 9 pairs of paragenitals; 1 median unpaired seta between coxae IV; ovipositor with 20 setae of undeterminable position. *Legs* (figs. 113, 114): Claws with row of minute rays each, lateral rays wanting; measurements: tibia I, 73 μ; tarsus I, 128 μ; tibia II, 68 μ; tarsus II, 133 μ. Chaetotaxy: coxae I-IV, 5 (of which 1 longer than femur II), 1, 5, 2 tactile setae; trochanters I-IV, 2, 2, 2, 1 tactile setae; basifemora I-IV, 8, 8, 7, 5 tactile setae; telofemora I-IV, 5, 5, 4, 4 tactile setae; genua I-IV, each with 4 tactile setae and duplex seta with microseta in form of short, hollow peg; tibia I, 8 tactiles, 2 attenuate sensory setae, 1 peg, trichoboth; tibia II, 8 tactiles, 1 attenuate and 1 blunt sensory seta; tibia III, 8 tactiles, 1 attenuate sensory seta; tibia IV, 9 tactiles, trichoboth; tarsus I, 12 minutely pilose ventrals in 2 rows, 8 lateral and 2 dorsal tactile setae, 1 attenuate and 2 blunt sensory setae, dorsoterminals solid, minutely pilose; tarsus II, similar to tarsus I, except lacking 1 attenuate and 1 blunt sensory seta; tarsus III, ventrals, laterals and dorsoterminals as in tarsus I, trichoboth; tarsus IV, ventrals and dorsoterminals as in tarsus I, 6 lateral tactile setae, 1 attenuate sensory seta.

Male: Identical to female, except slightly smaller in general size; total length, 710 μ; amphioid sclerites as in fig. 173.

Holotype: Male, 10 miles east of Xilitla, San Luis Potosí, Mexico, July 25, 1954, Warren T. Atyeo, beating bamboo.

Allotype: Female, same data as holotype.

Paratypes: Six males, nine females, same data as holotype; one male, one female, 12 miles east of Xilitla, San Luis Potosí, Mexico, June 20, 1955, R. E. Beer, on bamboo; one male, 10 miles east of Tuxtla Gutierrez, Chiapas, Mexico, July 8, 1955, R. E. Beer, under rock; one female, Huatusco, Veracruz, Mexico, at Brownsville, Texas, August 22, 1949, with orchid plants.

Location of type: The holotype, allotype, and thirteen paratypes deposited at the Snow Entomological Museum; two paratypes deposited at each of the following: the United States National Museum, the British Museum (Natural History), and the South Australian Museum.

Remarks: The proximal setae on the appendages tend to be minutely pilose while the distal setae tend to be pilose. Except for the slight variation in the number of tactile setae on the leg segments, the other features of this species are very stable. Total length, including gnathosoma, approximately 699 μ to 800 μ. Drawings of the holotype.

Genus *Trachymolgus* Berlese

Trachymolgus Berlese, 1923, Redia, vol. 15, p. 242. (Type: *Bdella nigerrima* Canestrini and Fanzago, 1876 [by original designation].)

Although related to *Cyta,* this European genus has two unique features. The integument of the idiosoma is heavily sclerotized and reticulated, and instead of round genital tracheae, this group is characterized by platytracheae which expand near their terminations over coxae II (Grandjean, 1938). The chelicerae are normal and the small chelae are dentate. The cheliceral setae are arranged as in *Cyta,* that is, the distal seta is inserted at the base of the fixed digit. The palpal tibiotarsus is not strongly shortened nor widened distally, but elongated as in *Biscirus* and *Monotrichobdella.* Two pairs of widely separated eyes and four pairs of setae occur on the dorsal propodosoma; the podocephalic canal is an internal tube (Grandjean, 1938). Three pairs of trichoboths are inserted on the legs. Specimens of this genus were not available for examination.

Spinibdellinae Grandjean, 1938

The Spinibdellinae is distinguished by two pairs of conspicuous ventral hypostomal setae, four pairs of trichoboths, and well developed genital tracheae. The palpal tibiotarsus is truncate and shorter than the combined length of the genu and telofemur in *Spinibdella* or cylindrical and longer than the combined segments in *Biscirus* and *Monotrichobdella.* The subequal end setae are as long, or longer than the palpal femur. Elongated chelicerae bear two setae inserted on the distal two thirds and small, needlelike chelae. The dorsal propodosoma with or without lateral propodosomal setae; secondary apodemes absent or poorly developed; two or four eyes lateral to the unmodified posterior pseudostigmatic organs; and the propocephalic canal is an internal tube (Grandjean, 1938). If present, unpaired setae on the venter of the hysterosoma are between the coxae, not immediately anterior to the genital flaps.

The three genera comprising this subfamily are similar. They are separated primarily by the shape of the palpal tibiotarsus, the number of end setae, and the presence or absence of the lateral propodosomal setae.

Genus *Spinibdella* Sig Thor

Spinibdella Thor, 1930, Zool. Anz., vol. 92, no. 1, p. 22. (Type: *Spinibdella reducta* Thor, 1930 [by original designation].)

Spinibdella is closely related to *Biscirus,* but has a short and truncated palpal tibiotarsus, and the lateral propodosomal setae are present. The palpal genu has three or four setae, and the basifemur has more than two setae. The cheliceral setae may be minute or of medium length, with the distal seta not extending beyond the tips of the chelae. Striation patterns on the dorsum of the propodosoma appear to be specific as do the modified setae on the amphioid sclerites of the males.

KEY TO THE SPECIES OF SPINIBDELLA

1. Palpus much shorter than the hypostome; cheliceral setae minute ..... *tenuirostris* p. 424
   Palpus longer than hypostome; cheliceral setae conspicuous 2
2. Palpal tibiotarsus approximately the same length and diameter of palpal genu ..... *corticis* p. 426
   Palpal tibiotarsus longer and thicker than the genu 3
3. Blunt sensory seta on tibia II deeply recessed 4
   Blunt sensory seta on tibia II not recessed 5
4. One pair of eyes; internal humerals half of first interspaces *depressa* p. 428
   Two pairs of eyes; internal humerals equal to first interspaces *bifurcata* p. 430
5. Internal humerals equal to first interspaces; tibia II with one blunt sensory seta ..... *cronini* p. 432
   Internal humerals half of first interspaces; tibia II with one blunt and one attenuate sensory seta ..... *ornata* p. 434

Spinibdella tenuirostris (Ewing), new combination

(Figs. 32, 61, 123, 124, 157)

Bdella tenuirostris Ewing, 1914, Bull. Amer. Mus. Nat. Hist., vol. 37, p. 149.
Spinibdella wilsoni Jacot, 1938, Psyche, vol. 45, no. 2-3, pp. 129-130 (new synonym).

This species is closely related to, or conspecific with *Spinibdella reducta* Thor, 1930, and possibly *Spinibdella lignicola* (Berlese), 1892 (= *Bdella lignicola* Berlese), but the inadequate descriptions make it impossible to determine the true synonymies of this species. Both *tenuirostris* and *reducta* have the gnathosoma considerably longer than the palpus, and both have minute cheliceral setae. Berlese's species with "*setis mandibularum deficientibus vel minimis, palpisque cortioribus*" can not be evaluated with certainty.

Female: Color unknown. Body pear-shaped, weakly constricted; length, including gnathosoma, 1100 μ. *Gnathosoma:* Length, 330 μ;

palpus (fig. 61) considerably shorter than hypostome; measurements: I, 15 μ; II plus III, 153 μ; IV, 20 μ; V, 54 μ; *des,* 185 μ; *ves,* 160 μ. Chelicera nonstriated, 306 μ in length; setae small, each 9 μ in length, inserted on distal half of chelicera (fig. 32). Gnathosoma striated proximal to ventral setae; dorsal hypostomal setae wanting. *Dorsal propodosoma* (fig. 157): Striae coarsely broken; lateral propodosomals nude, 46 μ in length; median propodosomals nude, 60 μ in length; eyes subequal, separated by distance equal to 2 diameters of smaller, posterior pair, interval between eyes with transverse striae; distance between anterior sensilla, 90 μ. *Dorsal hysterosoma:* Setae nude; length of internal humeral, 83 μ, approximately three fourths of first interspace; external humeral, 83 μ in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae parallel; 3 pairs of anal setae; 3 pairs of paranals; postanals distant from termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 8 equal setae in linear arrangement; 10 pairs of paragenitals, anterior pair between coxae IV; ovipositor with 18 setae of interminable position. *Legs* (figs. 123, 124): Claws small, shorter than pretarsus, with 4-5 lateral rays; measurements: tibia I, 97 μ; tarsus I, 128 μ; tibia II, 78 μ; tarsus II, 119 μ. Chaetotaxy: coxae I-IV, 5, 5, 5, 3 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 11, 10, 9, 4 tactile setae; telofemora I-IV, 11, 10, 8, 6 tactile setae; genu I, 7 tactiles, 5 attenuate sensory setae, 1 small, solid seta; genu II, 7 tactiles and 1 attenuate sensory seta; genua III-IV, 7 tactiles, 1 attenuate sensory seta each; tibia I, 15 tactiles, 8 attenuate sensory setae, 1 attenuate peg, trichoboth; tibiae II-III, 13 tactiles, 1 attenuate and 1 blunt sensory seta; tibia IV, 12 tactiles, trichoboth; tarsus I, 14 plumose ventrals arranged in 2 rows, 9 lateral and 2 dorsal tactiles, 3 attenuate and 2 blunt sensory setae, 1 capitate peg, *dt 1* hollow, nude, *dt 2, 3* hollow; plumose; tarsus II, 12 plumose ventrals, 8 lateral and 2 dorsal tactile setae, 2 blunt sensory setae, 1 peg, *dt 1* solid, nude, *dt 2, 3* solid, plumose; tarsus III, 12 plumose ventrals, 9 laterals, trichoboth, dorsoterminals as in tarsus II; tarsus IV, 12 plumose ventrals, 7 laterals, trichoboth, attenuate sensory seta posterolateral of trichoboth, dorsoterminals as in tarsus II.

Male: Unknown.

Type: Female, *Bdella tenuirostris*, Xenia, Ohio, September 14, 1910, H. E. Ewing, under stones.

Location of type: The United States National Museum.

Remarks: Three female cotypes of *Spinibdella wilsoni* Jacot were examined; these were collected 7 miles from south point of North Beach, St. Augustine, Florida, March 7, 1928, E. F. Grossman, leaf litter of *Tamola littoralis* on shore bay. These cotypes are further identified by E. F. Grossman's code numbers: two females, G34Bd1 and one female, G34Bd3. In addition to the types, specimens were examined from Florida, Arkansas, Kansas, North Carolina, Vermont, Michigan, and California.

This is a highly variable species, and although subspeciation is probable, no correlations of characters can be made with the specimens available for study. Extensive variation occurs in the special sensory setae on tibia I, the chaetotaxy of the palpus, the number of setae in the genital region, and the general size. The California and Arkansas specimens have only one long attenuate sensory seta distal to the trichoboth on tibia I, whereas the specimens from other locales have two setae in this position. The proximal sensory setae of tibia I vary from five to six in number, and in the specimens from Florida, North Carolina, Arkansas and California, they are approximately one fourth the length of the tibia. In the Kansas specimens and the *wilsoni* cotypes, the same sensory setae are almost one half the tibial length.

Variation in the number of setae on the palpus is confined to the basifemur and genu. The Kansas specimens have five setae on the basifemur, while the remaining specimens have seven setae; the genua of individuals from Kansas, Michigan, and Florida (Jacot's cotypes) have four setae, the other specimens have only three. The genital setae vary from five to eight pairs, and there may be as many as two unpaired paragenital setae between the posterior coxae. Total length varies from 880 μ to 1420 μ. Drawings of Ewing's type.

Spinibdella corticis (Ewing), new combination

(Figs. 33, 66, 127, 128, 156)

Bdella corticis Ewing, 1909, Can. Ent., vol. 41, no. 4, p. 122.

Although related to *Spinibdella bifurcata*, sp. nov., this species is distinctive in having the palpal tibiotarsus approximately equal in length and diameter to the palpal genu. *S. bifurcata*, as well as the other known species of this genus, has the palpal tibiotarsus considerably larger than the genu.

Female: Color unknown. Body pear-shaped; length, including gnathosoma, 1243 μ. *Gnathosoma:* Length, 391 μ; palpus (fig. 66) with genu longer than tibiotarsus; measurements: I, 25 μ; II, 291 μ;

III, 33 μ; IV, 58 μ; V, 50 μ; *des,* 417 μ; *ves,* 349 μ. Chelicera (fig. 33) striated, 347 μ in length; setae as figured. Gnathosoma striated; dorsal hypostomal setae conspicuous, 48 μ in length. *Dorsal propodosoma* (fig. 156): Striae sparsely broken; lateral propodosomals with minute branchings, 84 μ in length; median propodosomals branched, 126 μ in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes with longitudinal striae; distance between anterior sensilla, 68 μ. *Dorsal hysterosoma:* Setae branched; length of internal humeral, 118 μ, approximately the length of the first interspace; external humeral, 149 μ in length; sacrals in strongly curving transverse row, clunals in subtrapazoidal arrangement. *Anal region:* Border striae parallel, 2 pairs of anal setae; 1 pair of paranals; postanals flanking anal cleft, shorter than clunals. *Genital region:* Each genital plate with 10 long setae in linear arrangement; 28 pairs of paragenitals, anterior 4 pairs between coxae IV; median, unpaired setae wanting; genital discs small, distant; ovipositor short, with 14 pairs of subapical setae. *Legs* (figs. 127, 128): Claws small, shorter than pretarsus, each with one row of minute lateral rays; measurements: tibia I, 99 μ; tarsus I, 126 μ; tibia II, 99 μ; tarsus II, 137 μ. Chaetotaxy: coxae I-IV, 10, 8, 8, 7 tactile setae, many equal in length to basifemur I; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 13, 12, 7, 4 tactile setae; telofemora I-IV, 8, 9, 6, 6 tactile setae; genua I-III, 6 tactiles and 1 duplex seta each; genu IV, 6 tactiles; tibia I, 18 tactiles, 2 attenuate sensory setae, 1 peg, trichoboth; tibia II, 18 tactiles, 1 attenuate and 1 blunt sensory seta; tibia III, 15 tactiles, 1 attenuate sensory seta; tibia IV, 14 tactiles, trichoboth; tarsus I, 16 ventrals, 9 lateral and 2 dorsal tactiles, 1 attenuate and 2 blunt sensory setae, *dt 1, 3* hollow, nude, *dt 2* solid, nude; tarsus II, 17 ventral, 8 lateral and 2 dorsal tactile setae, 1 attenuate and 1 blunt sensory seta, *dt 2,* posterior *dt 1* solid, nude, *dt 3,* anterior *dt 1* hollow, nude; tarsus III, 20 ventrals, 8 laterals, trichoboth, *dt 1, 2* solid, nude, *dt 3* hollow, nude; tarsus IV, 19 ventrals, 6 laterals, trichoboth, setae of *dt 1* obliquely arranged, *dt 1, 2* solid, nude, *dt 3* hollow, nude.

Male: Unknown.

Type: Female, Urbana, Illinois, July 2, 1908, H. E. Ewing, under bark of cottonwood tree.

Location of type: The United States National Museum.

Remarks: The type specimen is incomplete and is 966 μ in length, slightly smaller than the specimen used for the redescription. Only

the type and five additional specimens were available for study; these latter specimens are identified by the following data: One female, six miles north of Chila, Puebla, Mexico, July 17, 1955, R. E. Beer, under stone; one female, Guatemala, at Brownsville, Texas, February 27, 1946, on *Odontoglossum* sp.; one female, south end of Cedar Mountains, Tooele Co., Utah, July 13, 1953, D. Porter; one female, Halsey, Thomas Co., Nebraska, 1954, W. F. Rapp, Jr., ex: duff; one female, Monte Alban, Oaxaca, Mexico, July 5, 1955, R. E. Beer, under rock.

In all the specimens, except the Utah female, the special sensory setae of tibia I are grouped in a small area distal to the trichoboth; in the Utah specimen, one of the attenuate sensory setae has migrated laterad of the trichoboth. The tactile setae of the three females from the more southern localities tend to have a greater diameter and to be more plumose than the same setae of the United States specimens.

The redescription and illustrations are based primarily on the female from Monte Alban, Oaxaca, Mexico.

Spinibdella depressa (Ewing), new combination

(Figs. 62, 119, 120, 158, 175)

Bdella depressa Ewing, 1909, Can. Ent., vol. 41, no. 4, p. 125.
Bdella virgata Ewing, 1910, Univ. Stud., Univ. Illinois, vol. 3, no. 6, p. 70 (new synonym).
Bdella chapultepecensis Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 177 (new synonym).
Bdella rio-lermensis Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 178 (new synonym).

Spinibdella depressa is closely related to *S. bifurcata,* sp. nov., but can be distinguished by the positions of the lateral propodosomal setae and the number of eyes. *S. depressa* has the lateral propodosomals approximate to the anterior sensilla rather than midway between the anterior and posterior sensilla, and has one pair of eyes rather than two pairs.

Female: Color in life light red with large black spots at posterolateral margins of the dorsal propodosoma. Body narrow, strongly constricted; length, including gnathosoma, 753 μ. *Gnathosoma:* Length, 195 μ; palpus (fig. 62) short, one half of tibiotarsus extending beyond hypostome; measurements: I, 14 μ; II plus III, 136 μ; IV, 17 μ; V, 40 μ; *des,* 168 μ; *ves,* 119 μ. Chelicera finely striated, 182 μ in length; setae inserted as in fig. 33. Gnathosoma striated; dorsal hypostomal setae small, 17 μ in length. *Dorsal propodosoma* (fig. 158): Striae sparsely broken; lateral propodosomals nude, 34 μ in length; median propodosomals plumose, 39 μ

in length; posterior pair of eyes wanting, former position indicated by striae forming teardrop pattern; distance between anterior sensilla, 45 μ. *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 34 μ, less than one half of first interspace; external humeral, 34 μ in length; sacrals and clunals in subtrapazoidal arrangement, external clunals lateral to termination of cleft. *Anal region:* Border striae parallel; 1 pair of anal setae; paranals wanting; postanals at posterior two thirds of cleft, anterior to external clunals. *Genital region:* Each genital plate with 9 equal genital setae in linear arrangement; 11 pairs of paragenitals; 4 median unpaired paragenitals, anterior unpaired seta between coxae III; genital discs small, 2 pairs in anterior half of vestibule, 1 pair in caudal fourth; ovipositor with 12 subapical and 6 postmedial setae. *Legs* (figs. 119, 120): Claws small, unadorned, shorter than pretarsus; measurements: tibia I, 52 μ; tarsus I, 65 μ; tibia II, 49 μ; tarsus II, 65 μ. Chaetotaxy: coxae I-IV, 9, 8, 7, 5 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 7, 8, 7, 3 tactile setae; telofemora I-IV, 5, 5, 4, 5 tactiles; genua I-III, 6 tactiles and 1 duplex seta each; genu IV, 7 tactiles; tibia I, 11 tactiles, 1 blunt and 1 attenuate sensory seta, 1 attenuate peg, trichoboth; tibia II, 7 tactiles, 1 recessed blunt sensory seta; tibia III, 12 tactiles, 1 attenuate sensory seta; tibia IV, 11 tactiles, trichoboth; tarsus I, 13 ventrals, 4 lateral and 2 dorsal tactiles, 1 attenuate and 2 blunt sensory setae, *dt 1, 3* hollow, nude, *dt 2* solid, nude; tarsus II, as in tarsus I except lacking 1 attenuate sensory seta and posterior *dt 1* solid, nude; tarsi III-IV, 13 ventrals, 4 laterals, trichoboth, *dt 1, 2* solid, nude, *dt 3* hollow, nude.

Male: Identical to female except in genital region: 12-13 pairs of genital setae; amphioid sclerites as in fig. 175.

Type: Female, Arcola, Illinois, July 4, 1908, H. E. Ewing, under bark.

Location of type: The United States National Museum.

Remarks: The following types were also available for study: *Bdella virgata* Ewing, female, Mahomet, Illinois, April 17, 1908, H. E. Ewing, under bark; *Bdella rio-lermensis* Baker and Balock, female, Rio Lerma, Mexico-Toluca Highway, Mexico, January 24, 1943, E. W. Baker, lichens; *Bdella chapultepecensis* Baker and Balock, male, Chapultepec Park, Mexico, Distrito Federal, Mexico, March 16, 1943, E. W. Baker, lichens. Additional males and females, totaling thirty-six specimens, were examined from Mexico (San

Luis Potosí, México, Morelos) and the United States (Texas, Maryland, Arkansas, Kansas, Illinois, New Jersey, Connecticut).

Of the widely distributed species, this group exhibits the least amount of variation. Total length varies from 590 μ to 780 μ, and only occasionally do the tactile setae of the legs vary from one more, to one less, than the numbers indicated in the description. Drawings of a male from: Palmetto State Park, Texas, April 4, 1954, R. E. Beer, spanish moss.

Spinibdella bifurcata, sp. nov.

(Figs. 1, 2, 63, 117, 118, 162, 174)

This species is closely related to *Spinibdella ornata,* sp. nov., but is distinguished by having one blunt sensory seta deeply recessed on tibia II rather than one blunt and one attenuate sensory seta. The amphioid sclerites of the males are unique in both species (figs. 174, 176).

Female: Color unknown. Body (figs. 1, 2) narrow, strongly constricted; length, including gnathosoma, 702 μ. *Gnathosoma:* Length, 178 μ; palpus (fig. 63) short, tibiotarsus extending beyond hypostome; measurements: I, 9 μ; II plus III, 125 μ; IV, 18 μ; V, 31 μ; *des,* 202 μ; *ves,* 135 μ. Chelicera striated, 167 μ in length; setae as in fig. 33. Gnathosoma striated; dorsal hypostomal setae wanting. *Dorsal propodosoma* (figs. 1, 162): Striae sparsely broken; lateral propodosomals nude, 48 μ in length; median propodosomals finely plumose, 51 μ in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes with longitudinal striae; distance between anterior sensilla, 44 μ. *Dorsal hysterosoma:* Setae finely plumose; length of internal humeral, 53 μ, approximately equal to first interspace; external humeral, 55 μ in length; sacrals in subtrapazoidal arrangement, external clunals wanting. *Anal region* (fig. 2): Border striae parallel; 2 pairs of anal setae; 1 pair of paranals; postanals flanking termination of cleft, shorter than clunals. *Genital region* (fig. 2): Each genital plate with 9 equal setae arranged in two rows; 15 pairs of paragenitals, anterior 3 pairs between coxae IV; median unpaired seta between coxae III wanting; genital discs small, distant; ovipositor with 12 subapical, 6 postmedial setae. *Legs* (figs. 117, 118): Claws unadorned, small, shorter than pretarsus; measurements: tibia I, 55 μ; tarsus I, 71 μ; tibia II, 48 μ; tarsus II, 70 μ. Chaetotaxy: coxae I-IV, 9, 8, 7, 6 tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 8, 8, 7, 3 tactile setae; telofemora I-IV, 6, 5, 4, 5 tactile setae; genu I, 5 tactiles, 1 duplex seta; genua II-III, 6 tactiles and 1 duplex

seta each; genu IV, 7 tactiles; tibia I, 14 tactiles, 1 attenuate and 1 blunt sensory seta, trichoboth; tibia II, 13 tactiles, 1 recessed, blunt sensory seta; tibia III, 15 tactiles, 1 attenuate sensory seta; tibia IV, 15 tactiles, trichoboth; tarsus I, 17 tactiles, 5 lateral and 2 dorsal tactiles, 1 attenuate and 2 blunt sensory setae, *dt 1, 3* hollow, nude, *dt 2* solid, nude; tarsus II, 15 ventrals, 5 lateral and 2 dorsal tactiles, 2 blunt sensory setae, *dt 2*, anterior *dt 1* solid, nude, *dt 3*, posterior *dt 1* hollow, nude; tarsus III, 18 ventrals, 8 laterals, trichoboth, *dt 1, 2* solid, nude, *dt 3* hollow, nude; tarsus IV, 17 ventrals, 6 laterals, trichoboth, dorsoterminals as in tarsus III.

Male: Identical to female except in genital region; each genital plate with 14 setae; amphioid sclerites as in fig. 174.

Holotype: Male, 10 miles west of Tuxtla Gutierrez, Chiapas, Mexico, July 8, 1955, R. E. Beer, under rock.

Allotype: Female, 16 miles north of Juchitan, Oaxaca, Mexico, July 2, 1955, R. E. Beer, free living on various plants.

Paratypes: Six males, five females, same data as the holotype; one female, same data as allotype; two males, 8 miles south of Nochistlan, Oaxaca, Mexico, June 30, 1955, R. E. Beer, under rock; two males, Monte Alban, Oaxaca, Mexico, July 17, 1955, R. E. Beer, under rock; one male, same data as the preceding, except collected July 15, 1955; one female, Huajuapam de Leon, Oaxaca, Mexico, July 17, 1955, R. E. Beer, under rock; one male, 17 miles north of Tehuitzingo, Puebla, Mexico, July 17, 1955, R. E. Beer, under rock; one male, one female, 3 miles north of Manzanillo, Michoacán, Mexico, July 26, 1955, R. E. Beer, on beach under coconut hull; one female, Mexico, at Brownsville, Texas, July 27, 1952, Smith, with pineapple fruit; one male, one female, 10 miles north of Edinburg, Texas, April 4, 1954, R. E. Beer, under log; two females, Corpus Christi State Park, Texas, August 6, 1955, R. E. Beer, under rock.

Location of types: The holotype, allotype, and twenty paratypes are deposited in the Snow Entomological Museum; two paratypes are deposited in each of the following: the United States National Museum, the South Australian Museum, and the British Museum (Natural History).

Remarks: The normally bifurcate seta on each of the amphioid sclerites (fig. 174) is undivided in one specimen, the resultant seta is unilaterally plumose. The genital plates of the female bear eight to ten pairs of setae, those of the males, thirteen to fourteen pairs. Other than these variations in the genital region and in total length,

which varies from 617 μ to 930 μ, the characteristic structures of this species are constant. This species is named *bifurcata* because of the unique structure of a median seta on each of the male amphioid sclerites. Drawings of the holotype.

Spinibdella cronini (Baker and Balock), new combination
(Figs. 65, 125, 126, 159, 160)

Bdella cronini Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7 p. 178.

The longitudinally or obliquely directed striae in the center of the propodosomal shield distinguishes this species from the closely related *Spinibdella ornata*, sp. nov., in which the striae are horizontally directed.

Female: Color in life pale red with darker markings on dorsolateral propodosoma. Body elongate, strongly constricted; length, including gnathosoma, 753μ (717-1257 μ). *Gnathosoma:* Length, 211 μ (194-247 μ); palpus (fig. 65) short, tibiotarsus extending beyond hypostome; measurements: I, 10 μ (9-15 μ); II plus III, 152 μ (126-175 μ); IV, 22 μ (21-27 μ); V, 36 μ (33-43 μ); *des*, 201 μ (170-254 μ); *ves*, 131 μ (122-167 μ). Chelicera striated, 196 μ (177-226 μ) in length; setae inserted as in fig. 33. Gnathosoma striated; dorsal hypostomal setae small, approximately 16 μ in length. *Dorsal propodosoma* (figs. 159, 160): Striae sparsely broken; lateral propodosomals thickened, nude (to slightly plumose), 49 μ (47-98 μ) in length; median propodosomals thickened, nude to plumose, 74 μ (53-82 μ) in length; eyes separated by distance equal to 2 diameters of anterior pair, interval between eyes with longitudinal striae; distance betwen anterior sensilla, 41 μ (41-76 μ). *Dorsal hysterosoma:* Setae thickened, nude (to plumose); length of internal humeral, 76 μ (54-118 μ), approximately equal to first interspace; external humeral, 69 μ (49-77 μ) in length; sacrals and clunals in subtrapazoidal arrangement. *Anal region:* Border striae parallel; 2 pairs of anal setae; paranals wanting; postanals flanking termination of cleft, shorter than clunals. *Genital region:* Each genital plate with 13 (13-16) equal, basally constricted setae in irregular linear arrangement; 21 (21-23) pairs of paragenital setae, anterior pairs between coxae III and IV; 2 (2-3) median, unpaired paragenital setae, anterior unpaired seta between coxae III; genital discs small, 2 pairs proximate in anterior half of vestibule, 1 pair in caudal one fourth; ovipositor short, seen only in axial view, 6 (5) pairs of setae anterior, 3 pairs posterior of center. *Legs* (figs. 125, 126): Claws nude, small, shorter than

pretarsus; measurements: tibia I, 58 μ (49-72 μ); tarsus I, 77 μ (65-97 μ); tibia II, 50 μ (45-65 μ); tarsus II, 76 μ (63-93 μ). Chaetotaxy: coxae I-IV, 7 (6), 7 (6-8), 7 (8), 6 (5) tactile setae; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 7, 7 (8), 5, 3 tactile setae; telofemora I-IV, 5, 5, 4, 4 (3) tactiles; genua I-IV, 5, 5, 5, 6 tactiles; tibia I, 13 (12) tactiles, 1 attenuate sensory seta, 1 peg, trichoboth; tibia II, 12 (13) tactiles, 1 blunt sensory seta; tibia III, 11 (12) tactiles, 1 attenuate sensory seta; tibia IV, 14 tactiles, trichoboth; tarsus I, 12 (11) ventrals, 6 (7) lateral and 2 dorsal tactile setae, 2 blunt sensory setae, *dt 1, 2* solid, nude, *dt 3* solid, nude (one or both may be hollow, nude); tarsus II, 11 (10) ventrals, 6 lateral and 2 dorsal tactiles, 2 blunt sensory setae, *dt 1, 2* solid, nude, anterior *dt 3* solid, nude (hollow, nude), posterior *dt 3* hollow, nude; tarsus III, 12 (11) ventrals, 6 laterals, trichoboth, dorsoterminals as in leg II; tarsus IV, 14 (12-14) ventrals, 7 (6) laterals, trichoboth, *dt 1, 2* solid, nude, *dt 3* hollow, nude.

Male: Unknown.

Type: Tritonymph, Planada, California, June 13, 1936, E. W. Baker, lichens from fig tree.

Location of type: The United States National Museum, type no. 1462.

Remarks: One hundred and forty-six females were examined, which included specimens from: Mexico (México, Tamaulipas, Guerrero, Neuvo León, San Luis Potosí) and the United States (Texas, California, Utah, Colorado, Washington, Alabama, Maryland).

This is the only species studied in which a marked variation occurs in the pattern of the dorsal propodosomal shield. The striae in the central area of the pattern in the Mexican specimens are oblique (fig. 159), while the same striae in the United States (Utah) specimens are longitudinally directed (fig. 160). Variation in the forms of the dorsoterminal setae at the apex of the tarsi can not be related to geographic area, nor does correlation exist between the different striation patterns and the various combinations of dorsoterminal setae.

The redescription and figures are based on a female with the following data: Cedar Mountains, Tooele County, Utah, December 12, 1954, D. Allred, Ex: pack rat (*Neotoma*) nest. The specimen used for the illustration of the Mexican shield pattern was collected at: 6 miles northeast of Jalostitlan, Jalisco, Mexico, August 19, 1954, W. T. Atyeo, under rock, altitude 6,000 feet.

Spinibdella ornata, sp. nov.

(Figs. 64, 121, 122, 161, 176)

This species is closely related to *Spinibdella bifurcata,* sp. nov., but is unique in having the duplex setae on the proximal halves of the genua, rather than the distal halves, and one blunt and one attenuate sensory seta on tibia II, rather than one deeply recessed blunt sensory seta. The internal humerals of *Spinibdella ornata* are about one half the length of the first interspaces, whereas in S. *bifurcata,* the internal humerals equal the first interspaces. Males can be easily recognized by the branched setae on the amphioid sclerites (fig. 176).

Female: Color unknown. Body narrow, strongly constricted; length, including gnathosoma, 900 μ. *Gnathosoma:* Length, 252 μ; palpus (fig. 64) short; measurements: I, 10 μ; II plus III, 167 μ; IV, 21 μ; V, 36 μ; *des,* 245 μ; *ves,* 167 μ. Chelicera striated, 239 μ in length; setae as in fig. 33. Gnathosoma striated; dorsal hypostomal setae, 25 μ in length. *Dorsal propodosoma* (fig. 161): Striae sparsely broken; lateral propodosomals nude, 41 μ in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes with longitudinal striae; distance between anterior sensilla, 53 μ. *Dorsal hysterosoma:* Setae finely branched; length of internal humeral, 37μ, approximately one half of first interspace; external humeral, 47 μ in length; sacrals and clunals in subtrapazoidal arrangement. *Anal region:* Border striae parallel, 2 pairs of anal setae, paranals wanting, postanals flanking termination of cleft. *Genital region:* Each genital plate with 10 small, attenuate setae in linear arrangement; 18 pairs of paragenitals, anterior pair between coxae IV; 2 median, unpaired setae anterior to genital aperture; genital discs equidistant, in posterior two thirds of vestibule; ovipositor with 12 subapical, 6 postmedial setae. *Legs* (figs. 121, 122): Claws with one row of lateral rays each; measurements: tibia I, 72 μ; tarsus I, 96 μ; tibia II, 61 μ; tarsus II, 90 μ. Chaetotaxy : coxae I-IV, 8, 7, 7, 6 tactile setae, length of each seta exceeding coxal width; trochanters I-IV, 1, 1, 2, 1 tactile setae; basifemora I-IV, 12, 8, 7, 3 tactile setae; telofemora I-IV, 9, 8, 5, 6 tactiles; genu I, 6 tactiles, 1 proximal duplex seta, 1 distal attenuate sensory seta; genua II-III, 6 tactiles and 1 proximal duplex seta each; genu IV, 8 tactiles; tibia I, 15 tactiles, 1 attenuate and 1 blunt sensory seta, 1 peg, trichoboth; tibia II, 13 tactiles, 1 attenuate and 1 blunt sensory seta; tibia III, 12 tactiles, 1 attenuate sensory seta; tibia IV, 15 tactiles, trichoboth; tarsus I, 17 ventrals, 8 lateral

and 2 dorsal tactile setae, 1 attenuate and 2 blunt sensory setae, 1 peg, *dt 1, 3* hollow, nude, *dt 2* solid, nude; tarsus II, 17 ventrals, 7 lateral and 1 dorsal tactile seta, 1 attenuate and 2 blunt sensory setae, 1 peg, *dt 1, 2* solid, nude, *dt 3* hollow, nude; tarsus III, 16 ventrals, 6 laterals, trichoboth, dorsoterminals as in tarsus II; tarsus IV, 17 ventrals, 5 laterals, trichoboth, setae of *dt 1* obliquely situated to each other, *dt 2, 3* as in tarsus II.

Male: Identical to female except in genital region: each genital plate with 17 equal setae, each about one half the length of female genital setae; amphioid sclerites as in fig. 176.

Holotype: Male, Bear Lake, Rocky Mountain National Park, Colorado, August 23, 1955, T. A. Woolley, moss and litter.

Allotype: Female, same data as holotype.

Paratypes: One female, same data as holotype; one female, Hope Valley, Alpine Co., California, July 22, 1955, N. A. Walker, lodge pole pine litter and humus, altitude 7,300 feet; one male, H. Cowell, Redwood State Park, 4 miles north of Santa Cruz, Santa Cruz Co., California, August 31, 1956, N. A. Walker, redwood litter, sample 294; one female, 3 miles north of Boulder Creek, Santa Cruz Co., California, August 31, 1956, N. A. Walker, redwood litter, sample 295.

Location of types: The holotype and three paratypes are deposited in the Snow Entomological Museum; the allotype at the Department of Zoology, Colorado A and M College, Fort Collins, Colorado; and one paratype is deposited at the United States National Museum.

Remarks: Variation between the Colorado and California specimens is not detectable. Total length varies from 660 μ to 923 μ, and the other measurements vary accordingly. This species is named *ornata* to call attention to the highly modified setae on the male amphioid sclerites. Drawings of the holotype.

Genus *Biscirus* Thor

Biscirus Thor, 1927, Ann. Mus. Leningrad, vol. 27, p. 135. (Type: *Bdella silvatica* Kramer, 1881 [by original designation].)

This genus is related to *Monotrichobdella*, but has two end setae rather than one. The palpal tibiotarsus is elongated and cylindrical, and in addition to the two end setae, has two other setae, as does the genu and the basifemur. The cheliceral setae do not extend beyond the tips of the chelae. The lateral propodosomal

setae are wanting; striation patterns on the dorsal propodosoma do not appear to be specific.

The majority of the species formally placed in this genu (Thor, 1931) appear to belong to *Thoribdella;* this would include such species as *Biscirus lapidarius* (Kramer), 1881; *B. intermedius* Thor, 1928; and *B. uncinatus* (Kramer), 1881. Only two species have been examined in the present study that definitely belong to this group, these are: *Biscirus silvaticus* (Kramer), 1881, and *B. thori* Womersley, 1933.

Biscirus silvaticus (Kramer)

(Figs. 10, 35, 67, 129, 130, 166, 177)

Bdella silvatica Kramer, 1881, Zeitsch. für Naturw., vol. 54, p. 445.

This species is related to the Australian species, *Biscirus thori* Womersley, but can be distinguished by the palpal genu being less than twice the length of the palpal telofemur, rather than the genu three times longer than the telofemur.

Female: Color in life dark red with deep blue blotches and black to purple eye spots. Body strongly constricted; length, including gnathosoma, 1210 μ (1100-1800 μ). *Gnathosoma:* Length, 349 μ (349-485 μ); palpus (fig. 67) with reduced number of setae; measurements: I, 14 μ (11-17 μ); II, 175 μ (175-491 μ); III, 29 μ (26-54 μ); IV, 43 μ (43-95 μ); V, 126 μ (114-221 μ); *des,* 235 μ (235-280 μ); *ves,* 170 μ (170-207 μ). Chelicera (fig. 10) elongate, striated, 345 μ (331-460 μ) in length; setae as figured. Hypostome striated, 349 μ (349-485 μ) in length; dorsal hypostomal setae wanting. *Dorsal propodosoma* (fig. 166): Striae coarsely broken; median propodosomals plumose, 65 μ (44-65 μ) in length; eyes separated by distance equal to diameter of anterior pair, interval between eyes with transverse striae; distance between anterior sensilla, 65 μ (65-103 μ). *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 51 μ (37-51 μ), approximately one third of first interspace; external humeral, 61 μ (37-61 μ) in length; sacrals and clunals in gently curving transverse rows. *Anal region:* Border striae parallel; one pair of anal setae; 2 pairs of paranals; postanals flanking termination of cleft, equal in length to external clunals. *Genital region:* Each genital plate with 15 (14) thin, nude genital setae arranged in 2 irregular rows; 12 (13) pairs of paragenitals, anterior pair between coxae IV; genital discs of moderate size, equidistant; ovipositor with 14 subapical setae. *Legs* (figs.

129, 130): Claws shorter than pretarsus, each with one row of lateral rays; measurements: tibia I, 102 μ (102-158 μ); tarsus I, 177 μ (170-218 μ); tibia II, 96 μ (88-129 μ); tarsus II, 170 μ (160-207 μ). Chaetotaxy: coxae I-IV, 4, 4, 5, 4 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 8, 9, 7, 4 tactile setae; telofemora I-IV, 5, 5, 4, 3 tactile setae; genu I, 3 tactiles, 4 attenuate sensory setae; genu II, 4 tactiles, 1 attenuate sensory seta; genu III, 4 tactile setae, 1 attenuate sensory seta; genu IV, 4 tactile setae; tibia I, 12 tactile setae, 4 attenuate sensory setae, 1 peg, trichoboth; tibia II, 13 tactile setae, 1 attenuate and 1 blunt sensory seta; tibia IV, 11 tactile setae, trichoboth; tarsus I, 15 plumose ventrals, 6 lateral and 1 dorsal tactile seta, 2 attenuate and 2 blunt sensory setae, *dt 1, 3* hollow, nude, anterior *dt 2* wanting, posterior *dt 2* solid, plumose; tarsus II, 14 plumose ventrals, 6 lateral and 2 dorsal tactiles, 2 blunt sensory setae, *dt 1, 2* solid, nude, *dt 3* hollow, nude; tarsus III, 16 plumose ventrals, 18 laterals, trichoboth, dorsoterminals as in tarsus II; tarsus IV, 13 plumose ventrals, 7 laterals, trichoboth, 1 attenuate sensory seta proximal to trichoboth, *dt 1* reduced to one solid, nude seta, *dt 2, 3* as in tarsus II.

Male: Identical to female except in genital region; each genital plate with 19-20 setae; amphioid sclerites as in fig. 177.

Type: Europe.

Location of type: Unknown.

Remarks: Specimens were examined from: Mexico (Oaxaca, Durango, Nuevo León), Haiti, the United States (California, Mississippi, Kansas, Colorado, Maryland, Tennessee), Iceland, and Germany (near Ost-Holstein).

Typically, the median propodosomals divide the interval between the posterior sensilla into three approximately equal parts, but considerable migration occurs around these points. The median propodosomals can be anterior to a line connecting the posterior sensilla (fig. 166) or they can be on that line, and can be closer to the posterior sensilla than to themselves, or vice versa.

Redescription and figures of a female from: ten miles south of China, Nuevo León, Mexico, August 4, 1955, R. E. Beer, under rock. The figure of the amphioid sclerites was prepared from a male from: University of Kansas campus, Lawrence, Douglas Co., Kansas, May 5, 1954, D. E. Sbur, under rock.

Genus *Monotrichobdella* Baker and Balock

Monotrichobdella Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 176. (Type: *Monotrichobdella max-osburni* Baker and Balock, 1944 [by original designation].)

This unique genus is related to *Biscirus,* but has one palpal end seta rather than two. The palpal tibiotarsus is elongate and cylindrical, and in addition to the single apical seta, there are three other setae on this segment; the genu may have one or two setae and the basifemur has two setae. The distal cheliceral seta extends beyond the tips of the chela. The lateral propodosomal setae are wanting; striation patterns on the dorsal propodosoma are similar to *Biscirus* species.

Monotrichobdella maxosburni Baker and Balock

(Figs. 34, 68, 131, 132, 168)

Monotrichobdella max-osburni Baker and Balock, 1944, Proc. Ent. Soc. Washington, vol. 46, no. 7, p. 176.

To date this is a monotypic genus. Adults have not been examined, but nymphal forms have been studied from two localities.

Tritonymph: Color in life red. Body ovoid, weakly constricted; length, including gnathosoma, 1350 μ. *Gnathosoma:* Length, 341 μ; palpus (fig. 68) with distal two thirds of tibiotarsus extending beyond hypostome; measurements: I, 11 μ; II plus III, 211 μ; IV, 31 μ; V, 102 μ; end seta, 216 μ. Chelicera (fig. 34) elongate, finely striated, 210 μ in length; chela smooth, needlelike, fixed digit two thirds length of movable digit; setae as figured. Gnathosomal base striated; hypostome nonstriated; *vh 1,* 65 μ from apex; *vh 2,* 218 μ from apex; dorsal hypostomal setae wanting. *Dorsal propodosoma* (fig. 168): Coarsley broken striae; median propodosomals plumose, 54 μ in length; eyes separated by distance equal to diameter of the anterior pair; distance between anterior sensilla, 82 μ. *Dorsal hysterosoma:* Setae plumose; length of internal humeral, 58 μ, approximately one half of first interspace; external humeral, 58 μ in length; sacrals in strongly curving transverse row; external clunals wanting. *Genital region:* Each genital plate with 9 fine, equal setae in irregular linear arrangement; 11 pairs of paragenitals, 1 unpaired seta and anterior 2 pairs of paragenitals between coxae IV; genital discs small, anterior pair one third the length of vestibule from anterior end, posterior pairs in caudal third; genitalia wanting. *Anal region:* Border striae parallel; 2 pairs of anal setae; 2 pairs of paranals; postanals flanking termination of cleft, shorter than clunal setae. *Legs* (figs. 131, 132): Each claw with one row of

lateral rays; measurements: tibia I, 85 μ; tarsus I, 134 μ; tibia II, 82 μ; tarsus II, 128 μ. Chaetotaxy: coxae I-IV, 4, 3, 4, 3 tactile setae; trochanters I-IV, 1 tactile seta each; basifemora I-IV, 7, 7, 7, 4 tactile setae; telofemora I-IV, 5, 5, 4, 4 tactile setae; genua I-III, 4 tactile setae and 1 attenuate sensory seta each; genu IV, 4 tactile setae; tibia I, 8 tactile setae, 3 attenuate sensory setae, 1 solid, attenuate peg, trichoboth; tibia II, 9 tactile setae, 1 attenuate sensory seta, 1 recessed, blunt sensory seta; tibia III, 8 tactile setae, 1 attenuate sensory seta; tibia IV, 6 tactile setae, trichoboth; tarsus I, 10 plumose ventral setae, 6 lateral and 1 dorsal tactile seta, 2 attenuate and 2 blunt sensory setae, 1 solid, attenuate peg, *dt 1*, 2 solid, nude, *dt* 3 hollow, nude; tarsus II, 10 plumose ventrals, 6 lateral and 1 dorsal tactile seta, 2 blunt sensory setae, dorsoterminals as in tarsus I; tarsus III, 10 plumose ventrals, 6 laterals, trichoboth, dorsoterminals as in tarsus I; tarsus IV, 10 plumose ventrals, 4 laterals, trichoboth, 1 attenuate sensory seta proximal to trichoboth, dorsoterminals as in tarsus I.

Female, Male: Not examined.

Holotype: Tritonymph, near Tres Cumbres, Mexico-Cuernavaca Highway, Morelos, Mexico (alt. 10,000 ft.), January 7, 1943, J. W. Balock and J. G. Shaw, lichens.

Location of type: The United States National Museum, type no. 1459.

Remarks: In addition to the type, two other specimens were available: one deutonymph, same data as the holotype, and one protonymph from: Salazar, Distrito Federal, Mexico, F. Bonet, September 30, 1942, moss.

The unpaired paragenital seta is not present in the protonymphal and deutonymphal stages. In other species having this unpaired seta, it is present in all stages of development, therefore, it is possible that the holotype is an aberrant specimen and that a median, unpaired paragenital seta is not a characteristic of this species, or that the unpaired seta occurs in only the tritonymphal and adult stages. Drawings of the holotype.

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FIGURE 1

Fig. 1. Dorsal aspect of *Spinibdella bifurcata*, sp. nov.

a. chelicera
b. gnathosomal base
c. anterior sensillum
d. lateral propodosomal
e. lateral eye
f. median propodosomal
g. posterior sensillum
h. internal humeral
i. external humeral
j. internal dorsal
k. internal lumbral
l. internal sacral
m. external sacral
n. internal clunal
o. posterior anal
p. anal seta
q. anal cleft

Figure 1

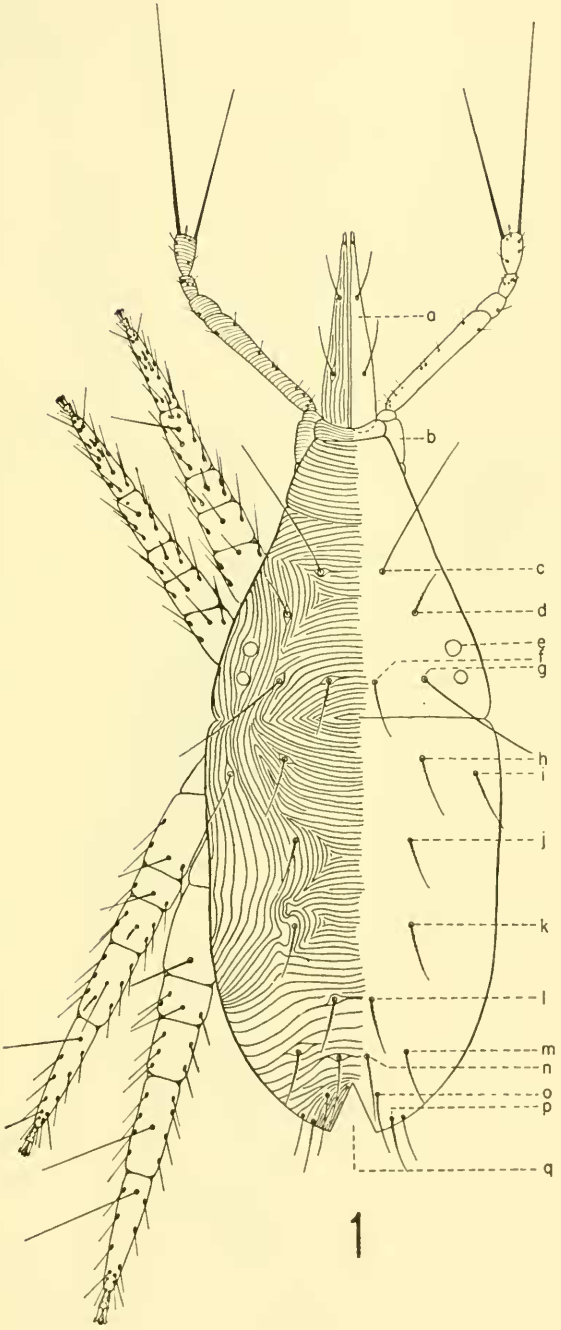
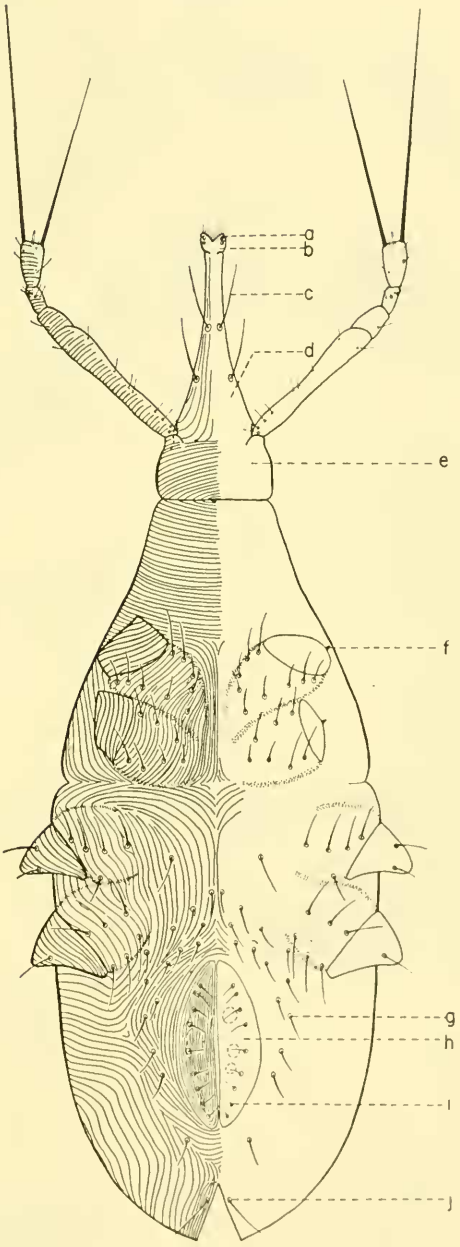


FIGURE 2

Fig. 2. Ventral aspect of *Spinibdella bifurcata,* sp. nov.

a. adornal setae
b. lateral lip
c. ventral hypostomal seta
d. buccal cone
e. gnathosomal base
f. coxal peg
g. paragenital seta
h. genital plate
i. genital seta
j. anal seta

Figure 2



2

FIGURES 3-11

Musculature of the appendages (figs. 3-6)

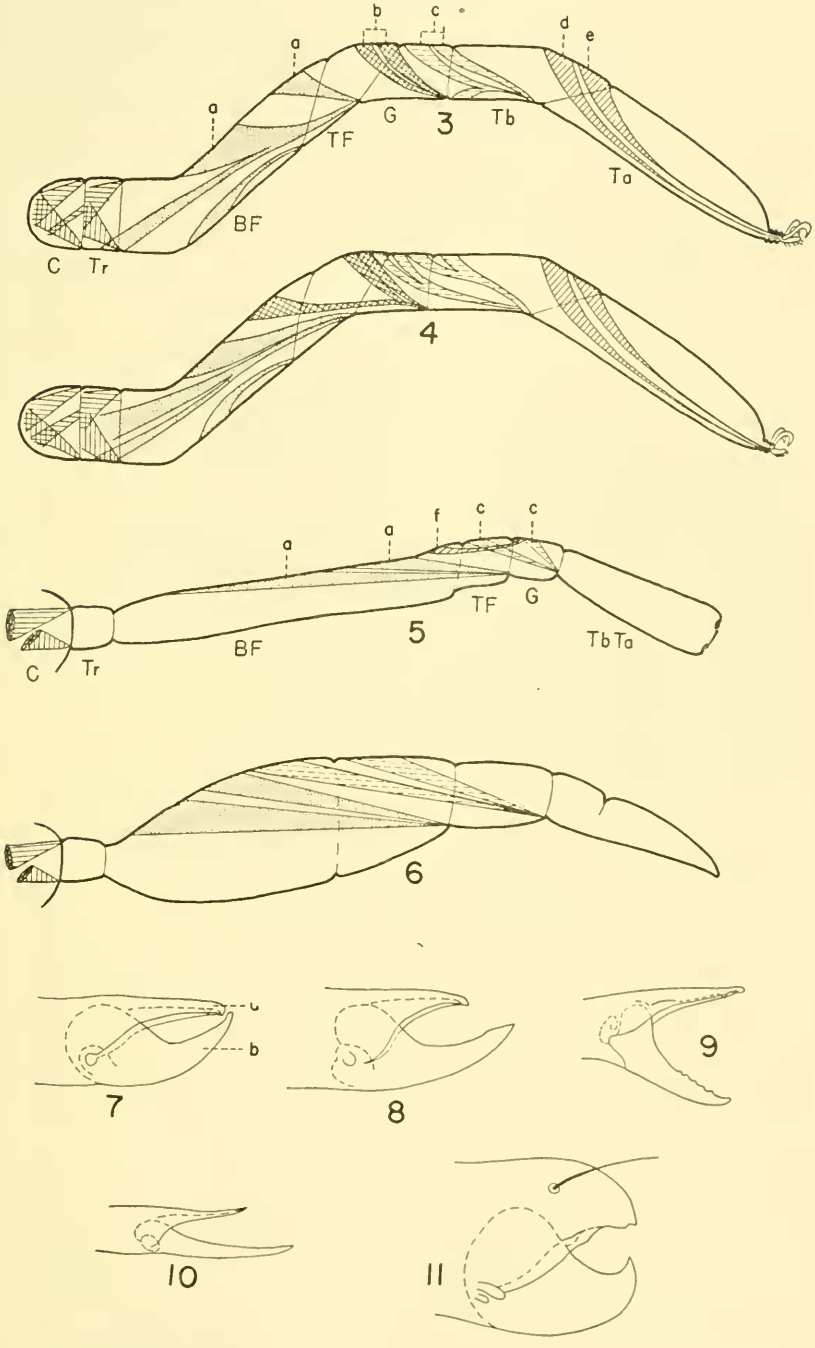
Fig. 3. Leg of *Bdella* species
Fig. 4. Leg of *Neomolgus* species
Fig. 5. Palpus of *Bdella* species
Fig. 6. Palpus of *Cunaxa* species

Legends for Figures 3-6

a. flexor muscle of genu
b. flexor muscle of tibia
c. flexor muscle of tarsus
d. depressor muscle of pretarsus
e. elevator muscle of pretarsus
f. extensor muscle of genu
C. coxa
Tr. trochanter
BF. basifemur
TF. telofemur
G. genu
Tb. tibia
Ta. tarsus
TbTa. fused tibiotarsus

Fig. 7. Chela of *Bdella longicornis*
a. fixed digit
b. movable digit
Fig. 8. Chela of *Thoribdella simplex*
Fig. 9. Chela of *Odontoscirus iota*
Fig. 10. Chela of *Biscirus silvaticus*
Fig. 11. Chela of *Cyta spuria*

Figures 3-11

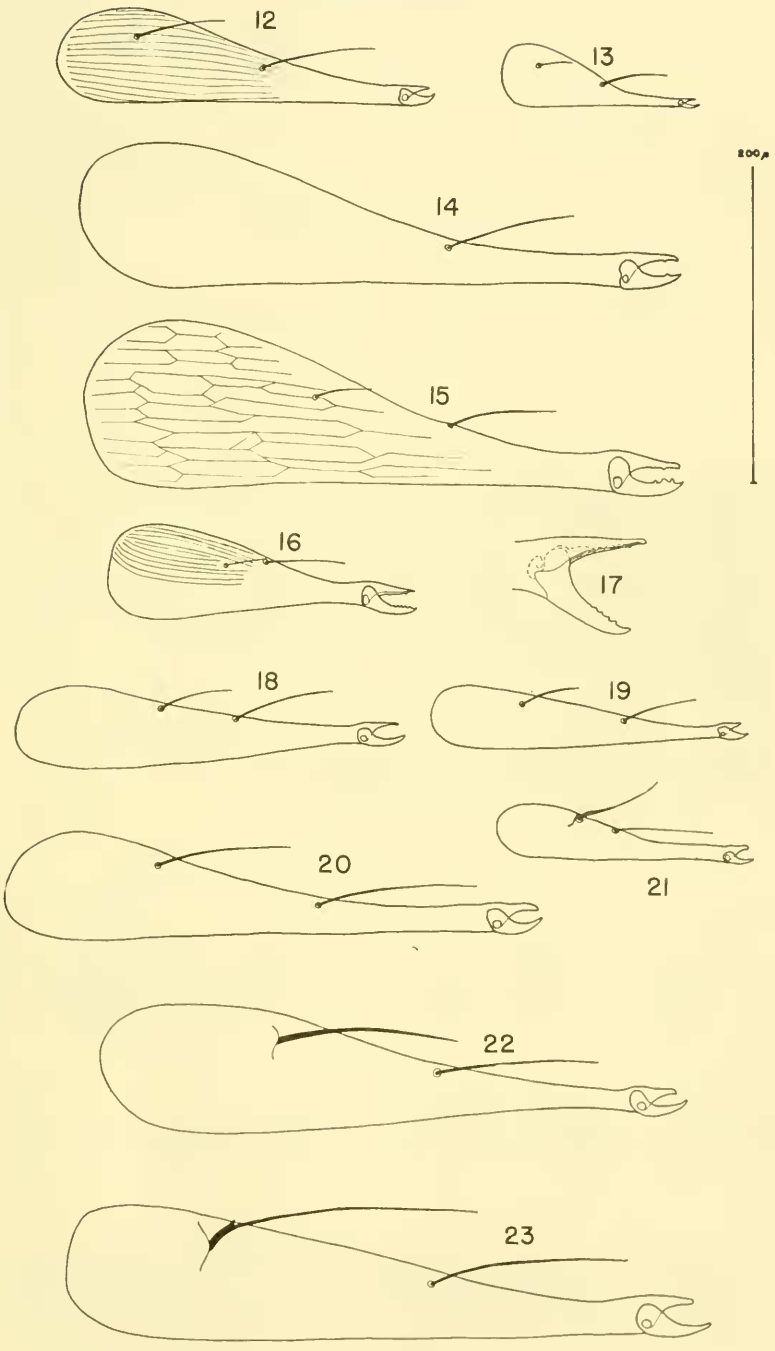


FIGURES 12-23

Lateral aspects of right chelicerae

Fig. 12. *Bdella longicornis*
Fig. 13. *Bdella mexicana*
Fig. 14. *Bdellodes longirostris*
Fig. 15. *Odontoscirus alpinus,* holotype
Fig. 16. *Odontoscirus iota,* holotype
Fig. 17. *Odontoscirus iota,* holotype
Fig. 18. *Octobdellodes hurdi,* holotype
Fig. 19. *Octobdellodes infrequens,* holotype
Fig. 20. *Octobdellodes infrequens,* allotype
Fig. 21. *Thoribdella meridionalis*
Fig. 22. *Thoribdella communis,* holotype
Fig. 23. *Thoribdella simplex,* holotype

Figures 12-23

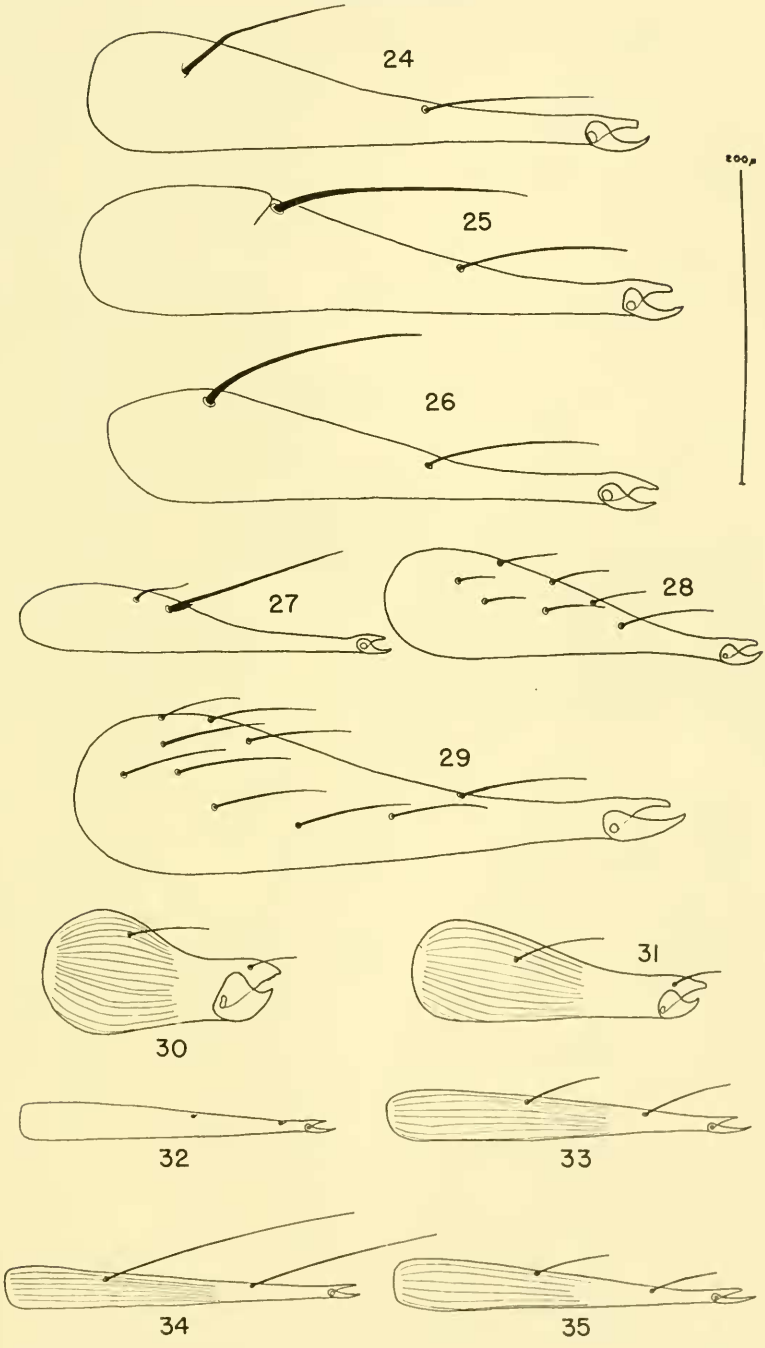


FIGURES 24-35

Lateral aspects of right chelicerae

Fig. 24. *Thoribdella truncata,* holotype
Fig. 25. *Thoribdella californica*
Fig. 26. *Thoribdella insolita,* holotype
Fig. 27. *Thoribdella spinosa,* holotype
Fig. 28. *Neomolgus mutabilis,* holotype
Fig. 29. *Neomolgus littoralis*
Fig. 30. *Cyta latirostris*
Fig. 31. *Cyta coerulipes*
Fig. 32. *Spinibdella tenuirostris,* type
Fig. 33. *Spinibdella corticis*
Fig. 34. *Monotrichobdella maxosburni,* type
Fig. 35. *Biscirus silvaticus*

Figures 24-35

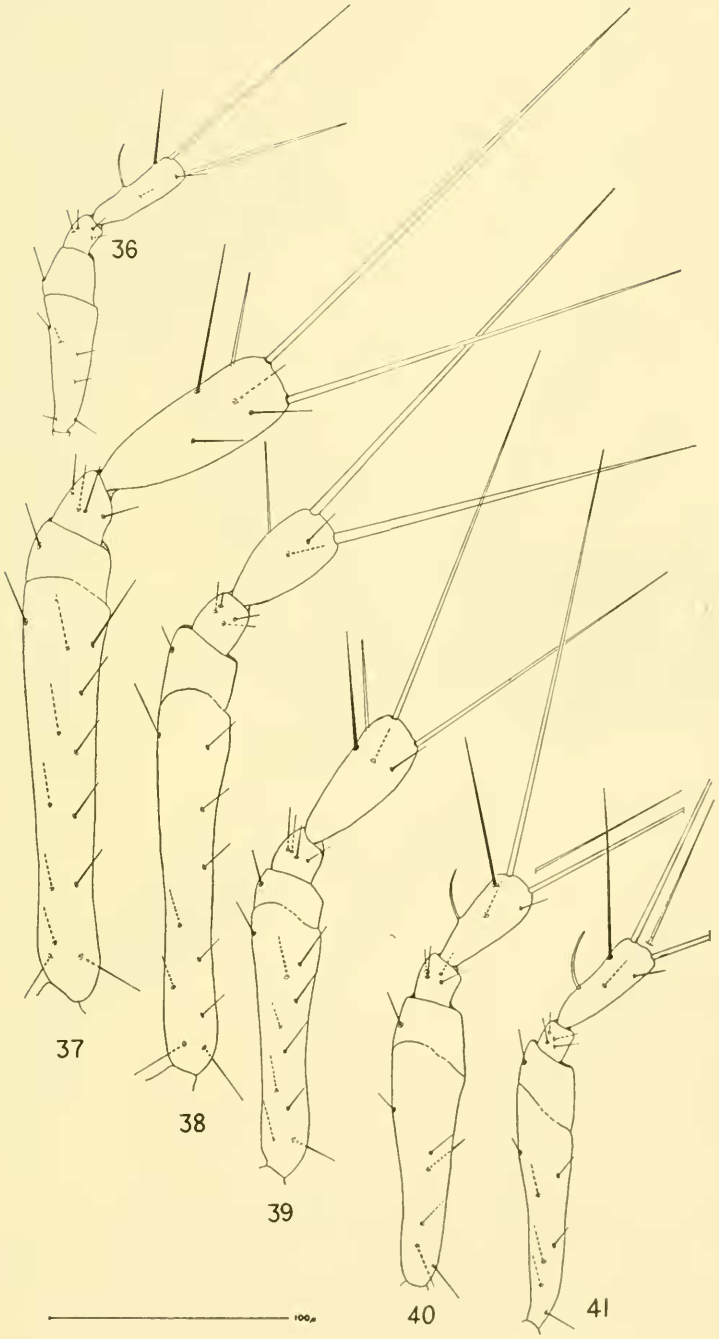


FIGURES 36-41

Median aspects of left palpi

Fig. 36. *Bdella mexicana,* type
Fig. 37. *Bdella longicornis*
Fig. 38. *Bdella longistriata,* holotype
Fig. 39. *Bdella muscorum*
Fig. 40. *Bdella tropica,* holotype
Fig. 41. *Bdella distincta,* lectotype

Figures 36-41

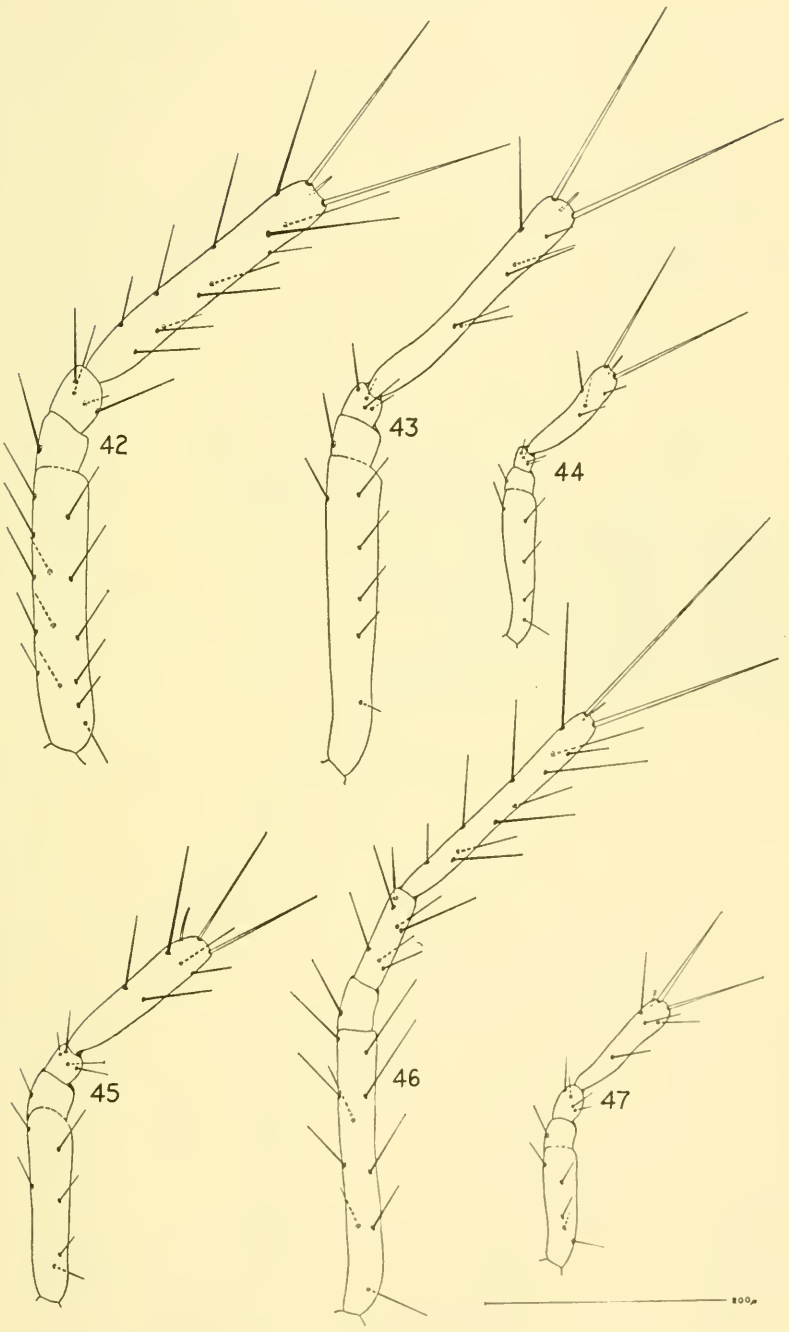


FIGURES 42-47

Median aspects of left palpi

Fig. 42. *Bdellodes longirostris*
Fig. 43. *Odontoscirus alpinus,* holotype
Fig. 44. *Odontoscirus iota,* holotype
Fig. 45. *Octobdellodes hurdi,* holotype
Fig. 46. *Octobdellodes infrequens,* holotype
Fig. 47. *Bdellodes bisetosa,* holotype

Figures 42-47

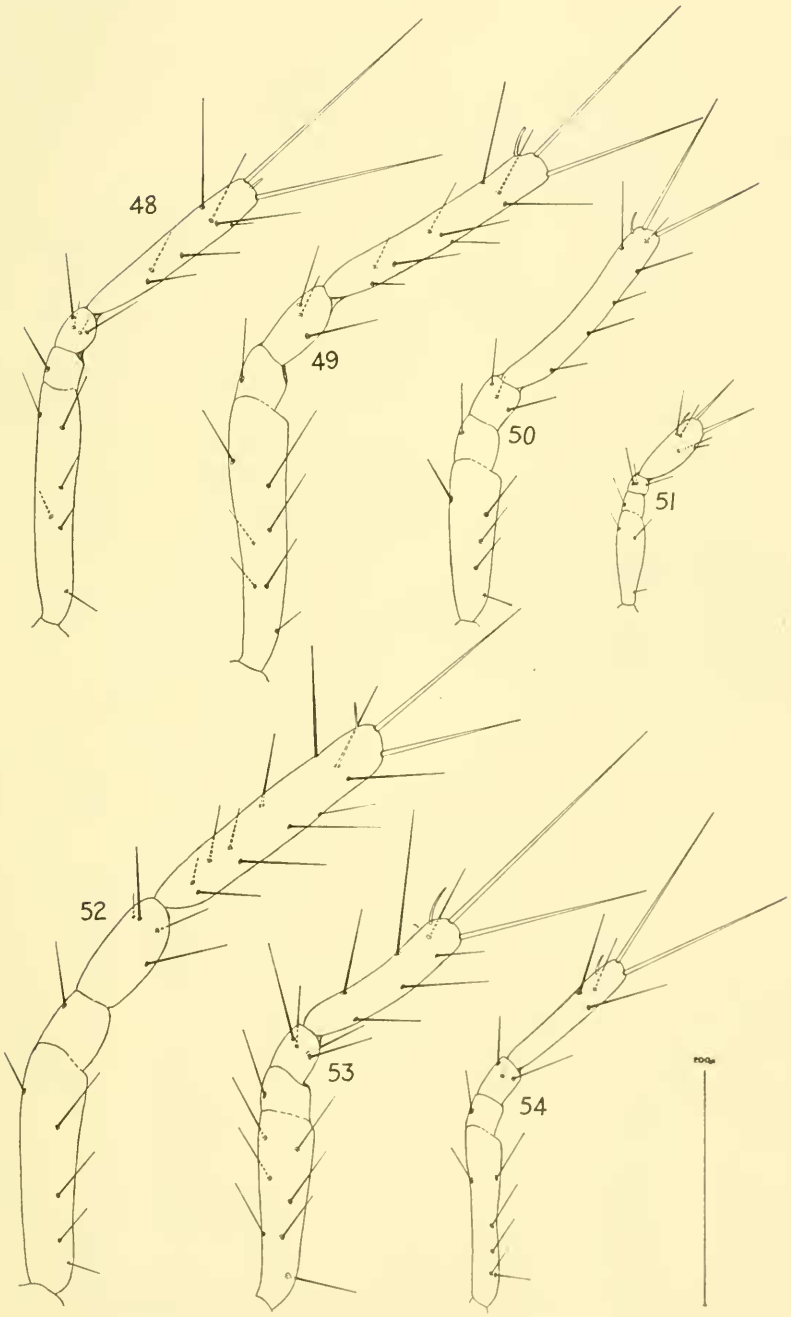


FIGURES 48-54

Median aspects of left palpi

Fig. 48. *Thoribdella communis,* holotype
Fig. 49. *Thoribdella simplex,* holotype
Fig. 50. *Thoribdella truncata,* holotype
Fig. 51. *Thoribdella meridionalis*
Fig. 52. *Thoribdella californica*
Fig. 53. *Thoribdella insolita,* holotype
Fig. 54. *Thoribdella spinosa,* holotype

Figures 48-54

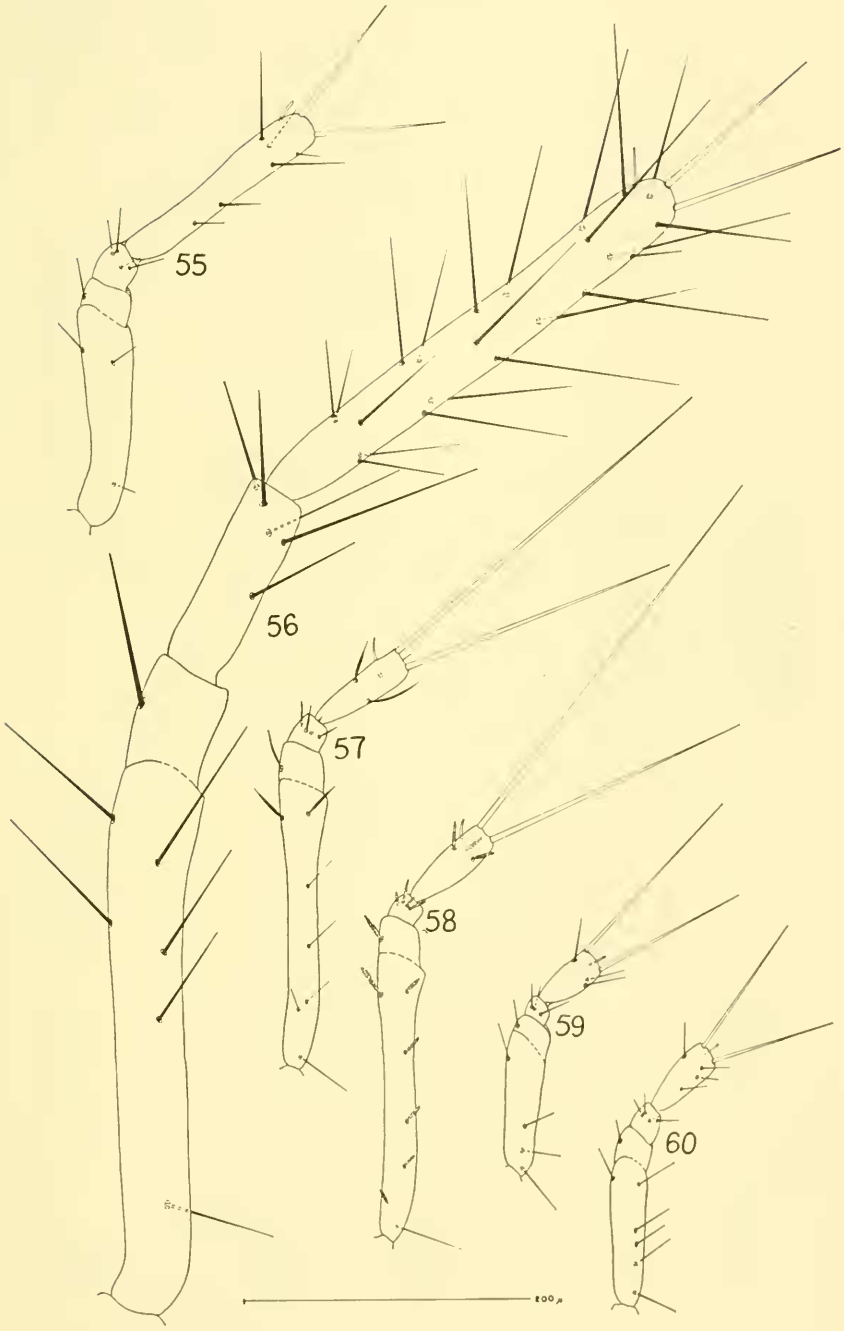


FIGURES 55-60

Median aspects of left palpi

Fig. 55. *Neomolgus mutabilis,* holotype
Fig. 56. *Neomolgus littoralis*
Fig. 57. *Cyta coerulipes,* nude setae
Fig. 58. *Cyta coerulipes,* plumose setae
Fig. 59. *Cyta spuria,* holotype
Fig. 60. *Cyta latirostris*

Figures 55-60



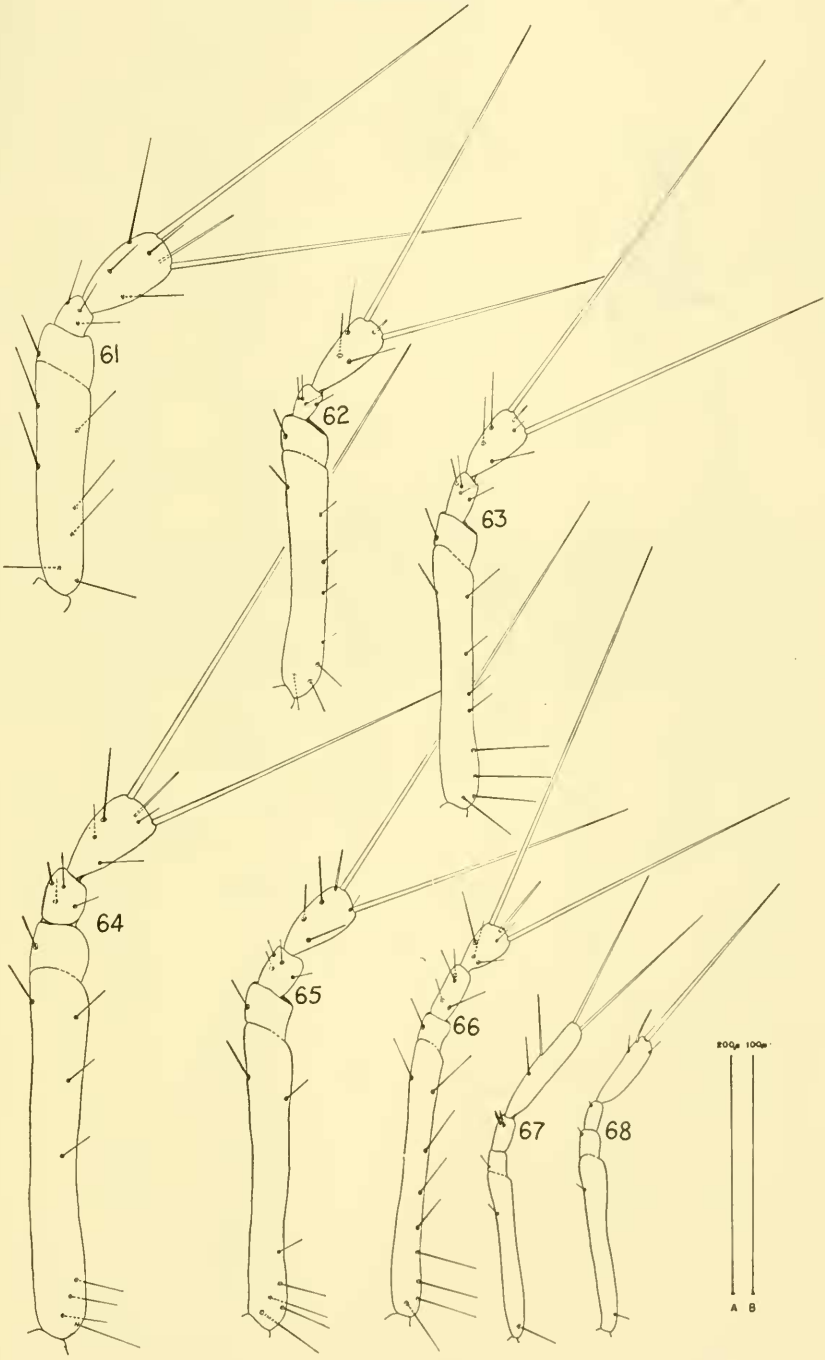
FIGURES 61-68

Median aspects of left palpi

(Figs. 61-65, scale A; figs. 66-68, scale B)

Fig. 61. *Spinibdella tenuirostris,* type
Fig. 62. *Spinibdella depressa*
Fig. 63. *Spinibdella bifurcata,* holotype
Fig. 64. *Spinibdella ornata,* holotype
Fig. 65. *Spinibdella cronini*
Fig. 66. *Spinibdella corticis*
Fig. 67. *Biscirus silvaticus*
Fig. 68. *Monotrichobdella maxosburni,* type (tritonymph)

Figures 61-68

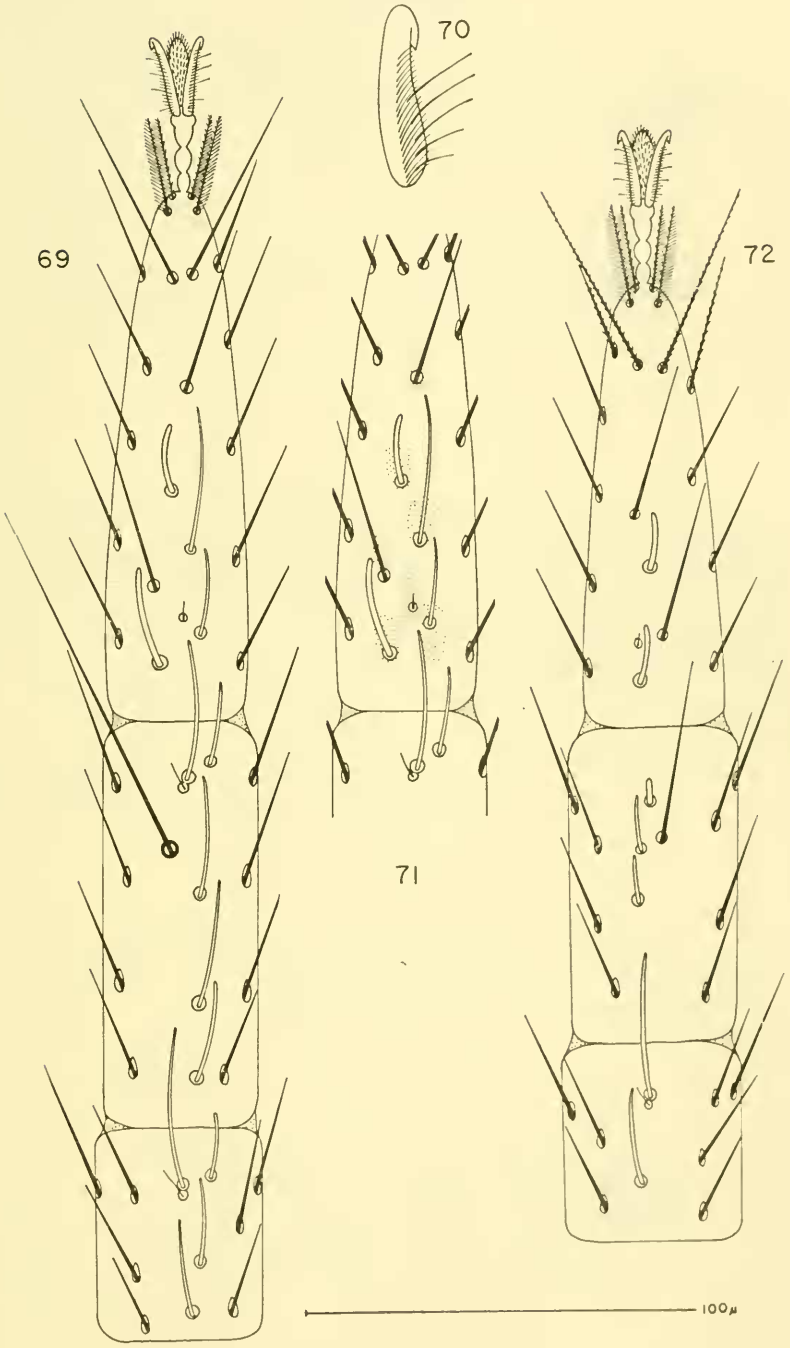


FIGURES 69-72

Dorsal aspect of legs I and II of *Bdella longicornis*

Fig. 69. Distal three segments of leg I
Fig. 70. Enlarged claw illustrating large and small lateral rays
Fig. 71. Tarsus I, stippled areas indicate extent of setal migration
Fig. 72. Distal three segments of leg II

Figures 69-72

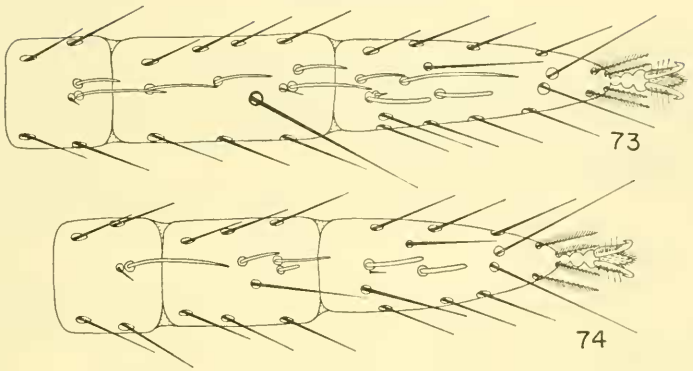


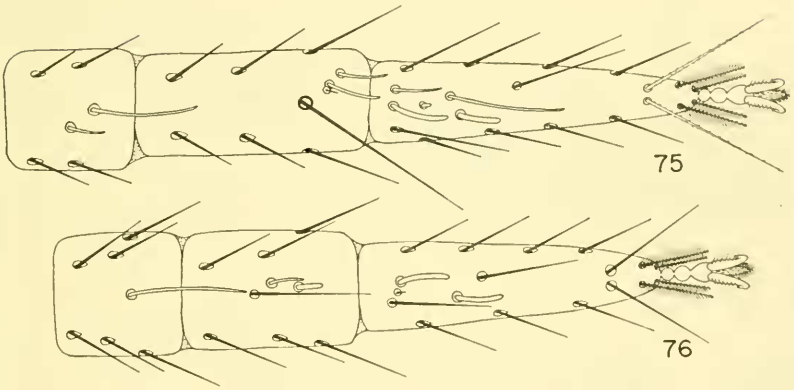
FIGURES 73-78

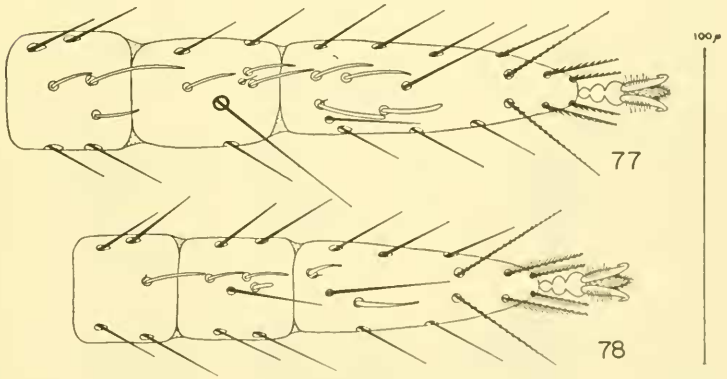
Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

Figs. 73, 74. *Bdella muscorum*
Figs. 75, 76. *Bdella longistriata,* holotype
Figs. 77, 78. *Bdella tropica,* holotype

Figures 73-78





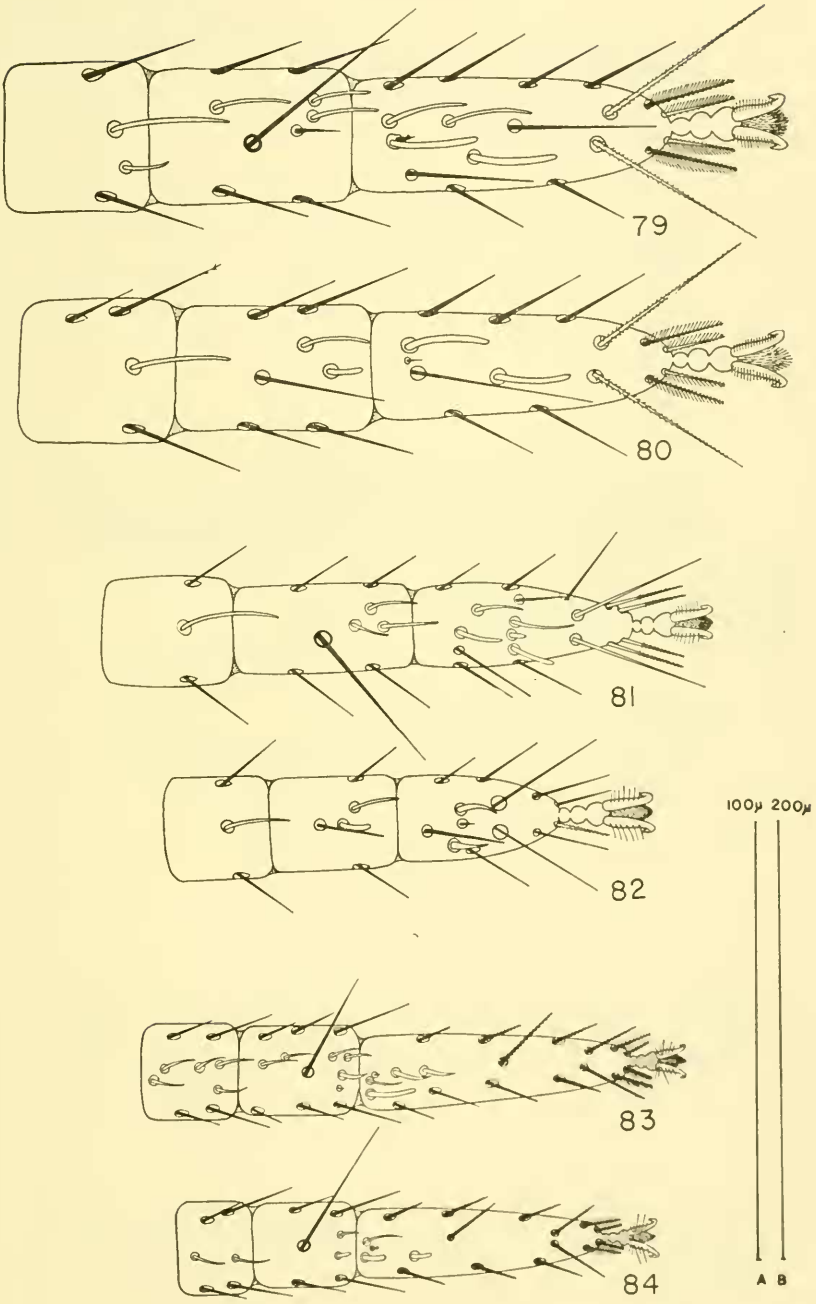


FIGURES 79-84

Dorsal aspect of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)
(Figs. 79-82, scale A; figs. 83-84, scale B)

Figs. 79, 80. *Bdella distincta,* lectotype
Figs. 81, 82. *Bdella mexicana,* type
Figs. 83, 84. *Odontoscirus iota,* holotype

Figures 79-84

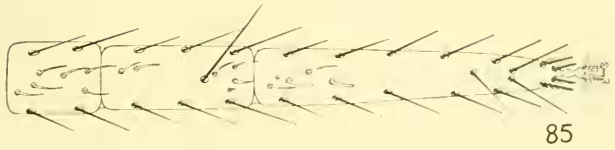


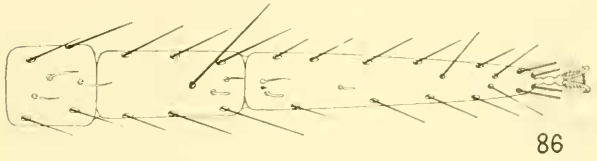
FIGURES 85-90

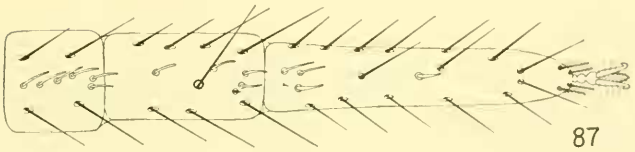
Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

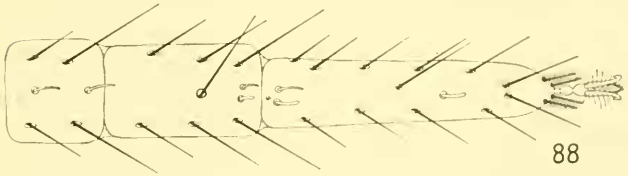
Figs. 85, 86. *Odontoscirus alpinus*, holotype
Figs. 87, 88. *Bdellodes longirostris*
Figs. 89, 90. *Octobdellodes infrequens*, holotype

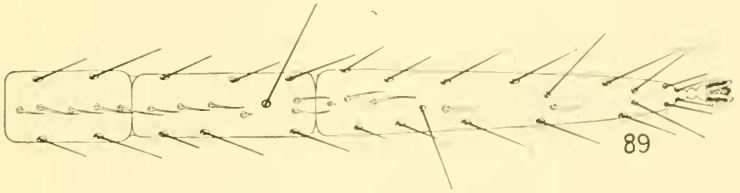
Figures 85-90









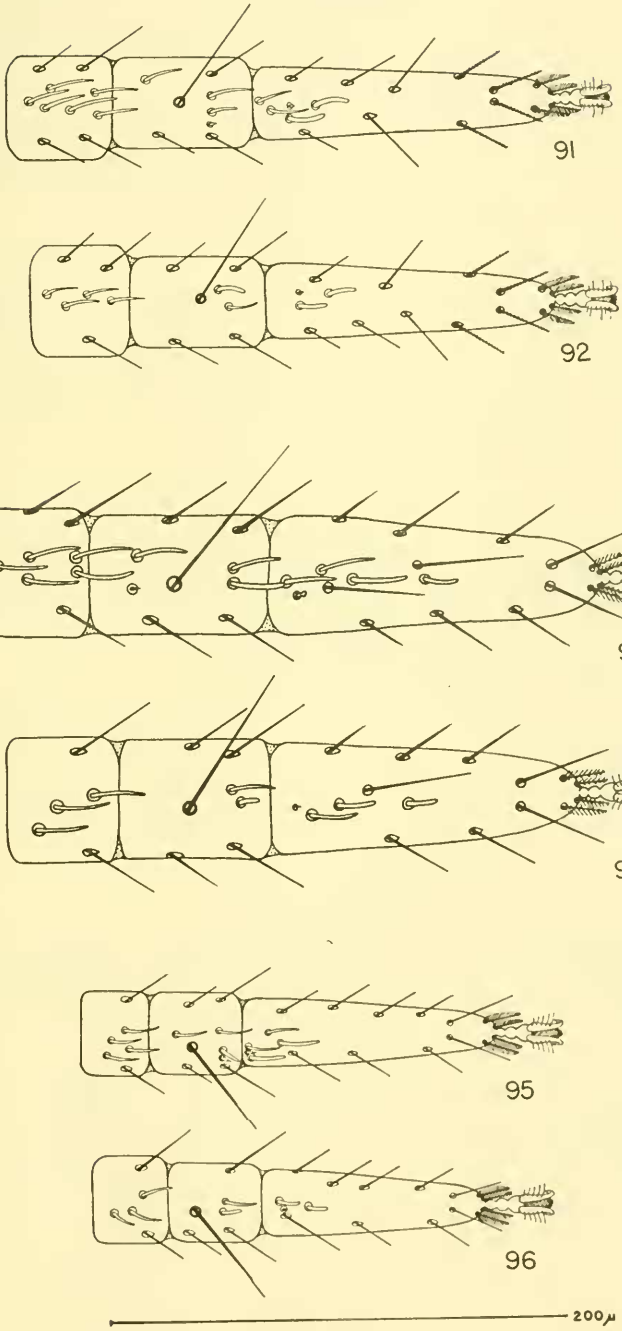


FIGURES 91-96

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

Figs. 91, 92. *Bdellodes bisetosa,* holotype
Figs. 93, 94. *Octobdellodes hurdi,* holotype
Figs. 95, 96. *Thoribdella meridionalis*

Figures 91-96

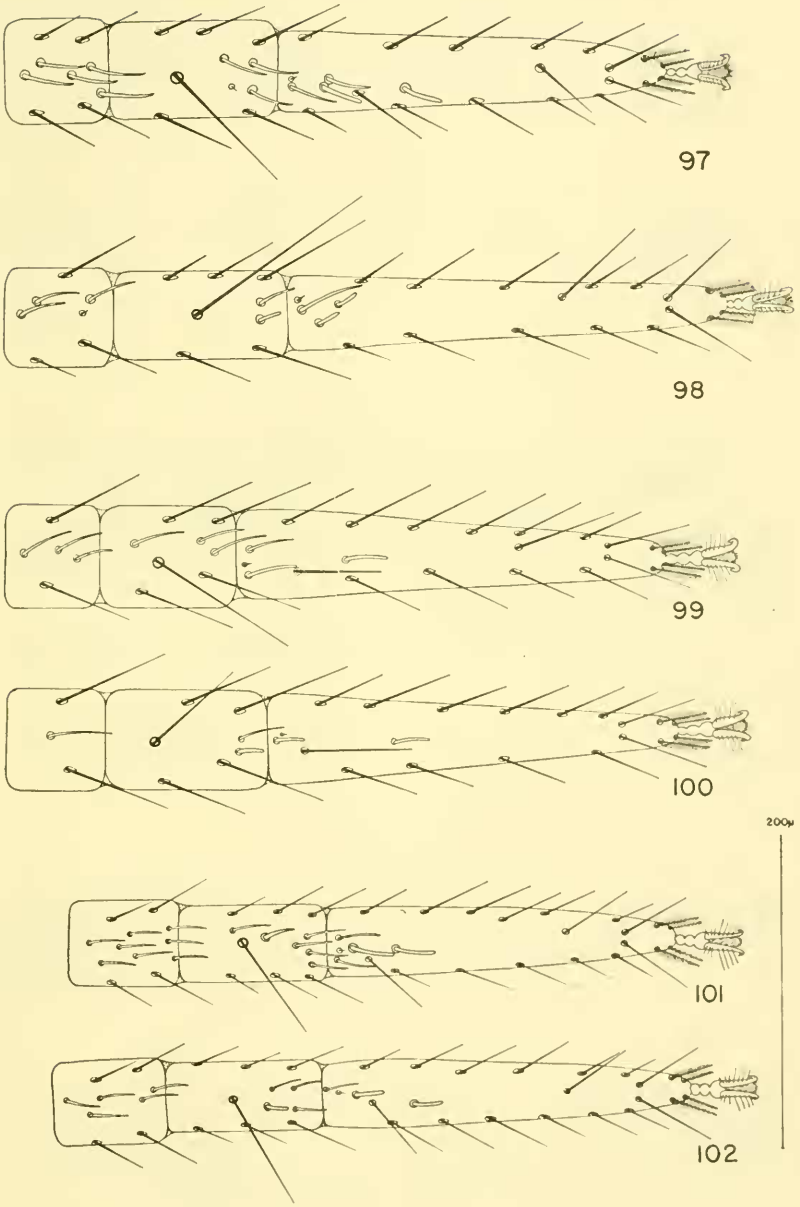


FIGURES 97-102

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

Figs. 97, 98. *Thoribdella communis,* holotype
Figs. 99, 100. *Thoribdella insolita,* holotype
Figs. 101, 102. *Thoribdella truncata,* holotype

Figures 97-102

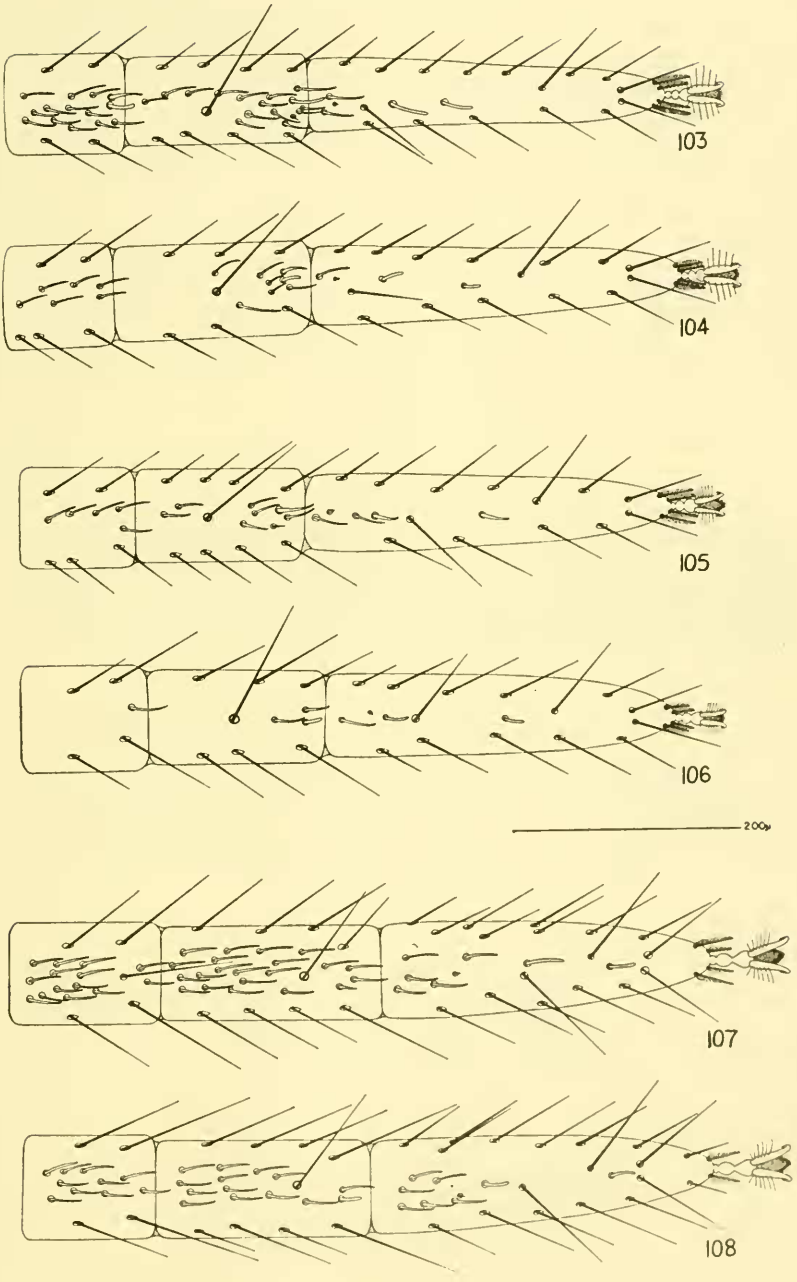


FIGURES 103-108

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

Figs. 103, 104. *Thoribdella simplex;* leg I, Kansas paratype; leg II, holotype
Figs. 105, 106. *Thoribdella californica*
Figs. 107, 108. *Neomolgus littoralis*

Figures 103-108

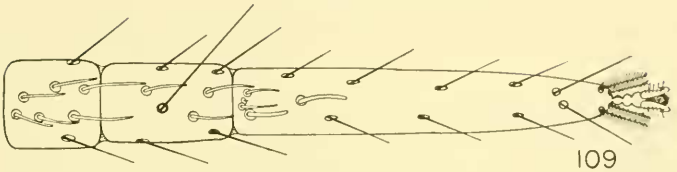


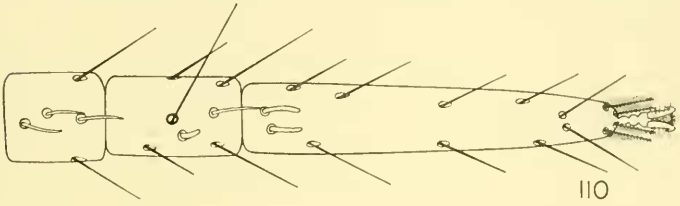
FIGURES 109-114

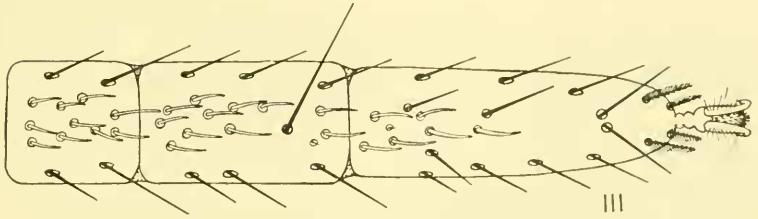
Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

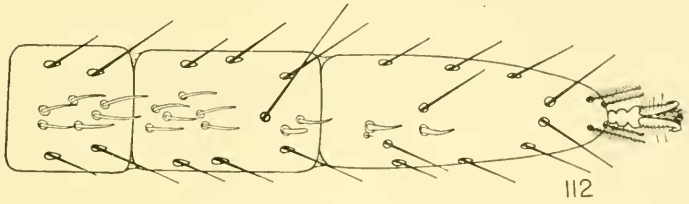
Figs. 109, 110. *Thoribdella spinosa,* holotype
Figs. 111, 112. *Neomolgus mutabilis,* holotype
Figs. 113, 114. *Cyta spuria,* holotype

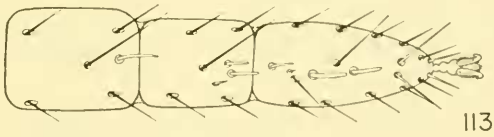
Figures 109-114

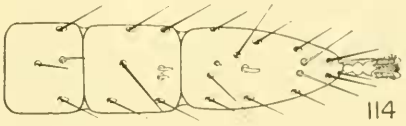










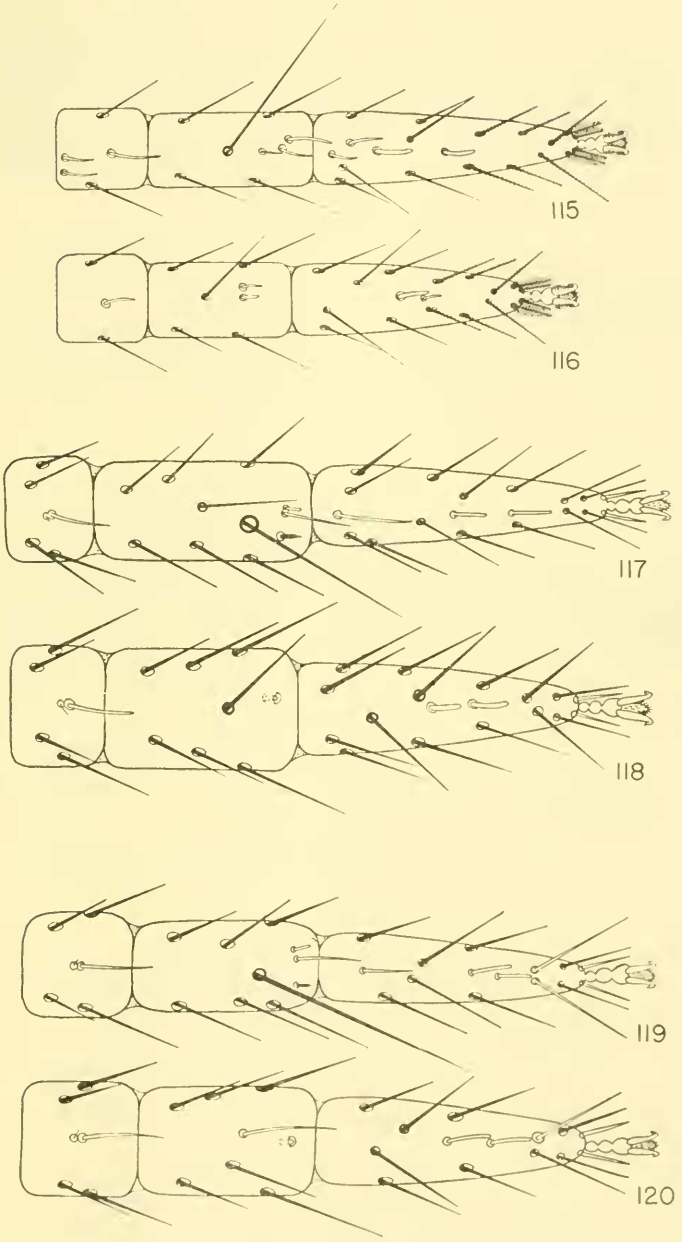


FIGURES 115-120

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)
(Figs 115, 116, scale A; figs. 117-120, scale B)

Figs. 115, 116. *Cyta coerulipes*
Figs. 117, 118. *Spinibdella bifurcata*, holotype
Figs. 119, 120. *Spinibdella depressa*

Figures 115-120

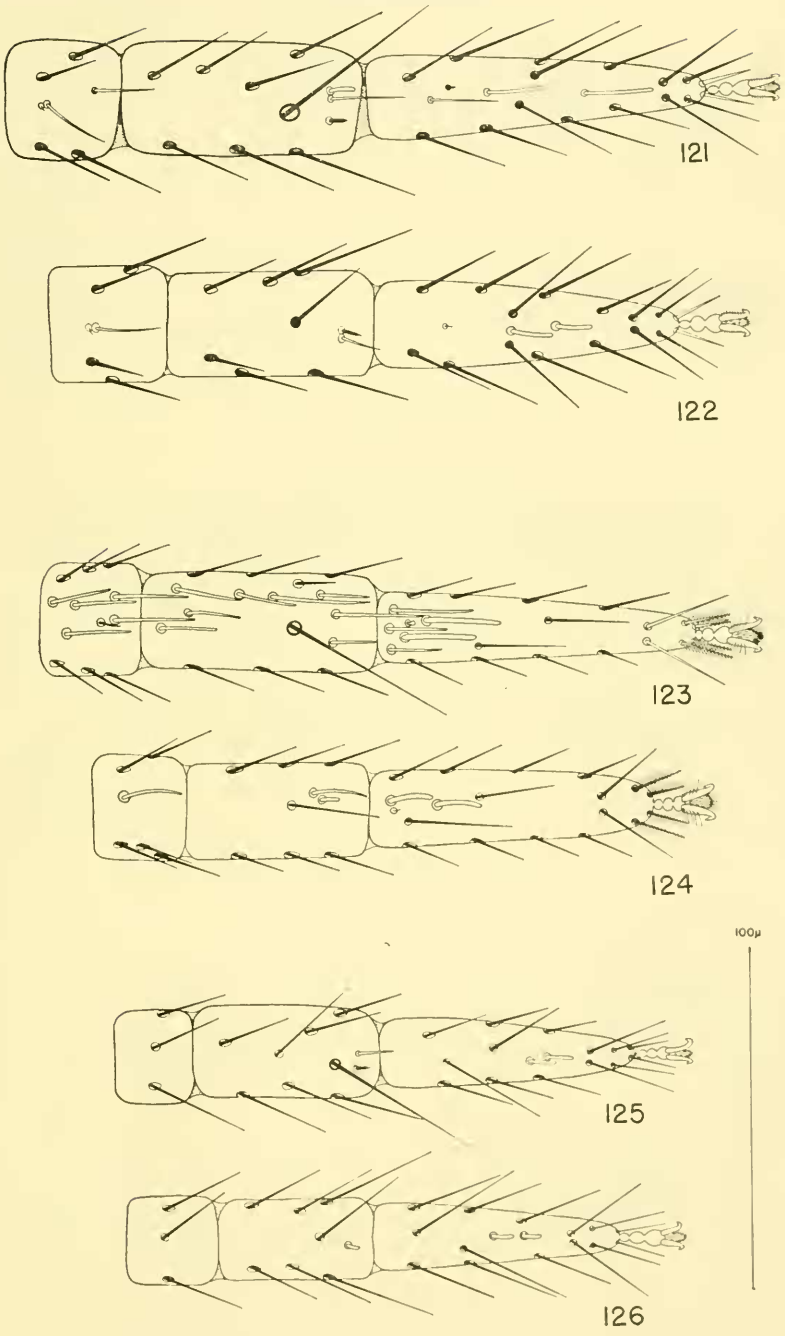


FIGURES 121-126

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)

Figs. 121, 122. *Spinibdella ornata,* holotype
Figs. 123, 124. *Spinibdella tenuirostris,* type
Figs. 125, 126. *Spinibdella cronini*

Figures 121-126

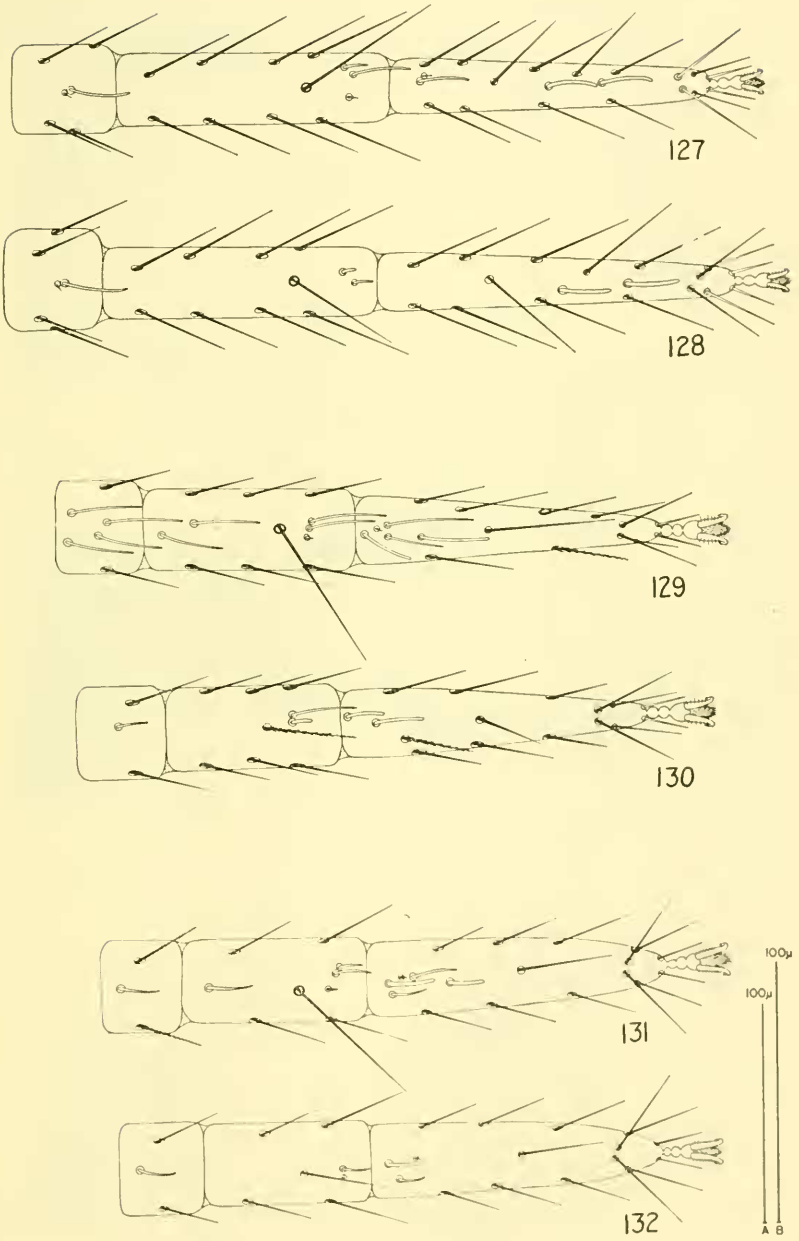


FIGURES 127-132

Dorsal aspects of the three distal segments of legs I and II
(Legs I, odd numbers; legs II, even numbers)
(Figs. 129-130, scale A; figs. 127-128, 131-132, scale B)

Figs. 127, 128. *Spinibdella corticis*
Figs. 129, 130. *Biscirus silvaticus*
Figs. 131, 132. *Monotrichobdella maxosburni*, type (tritonymph)

Figures 127-132



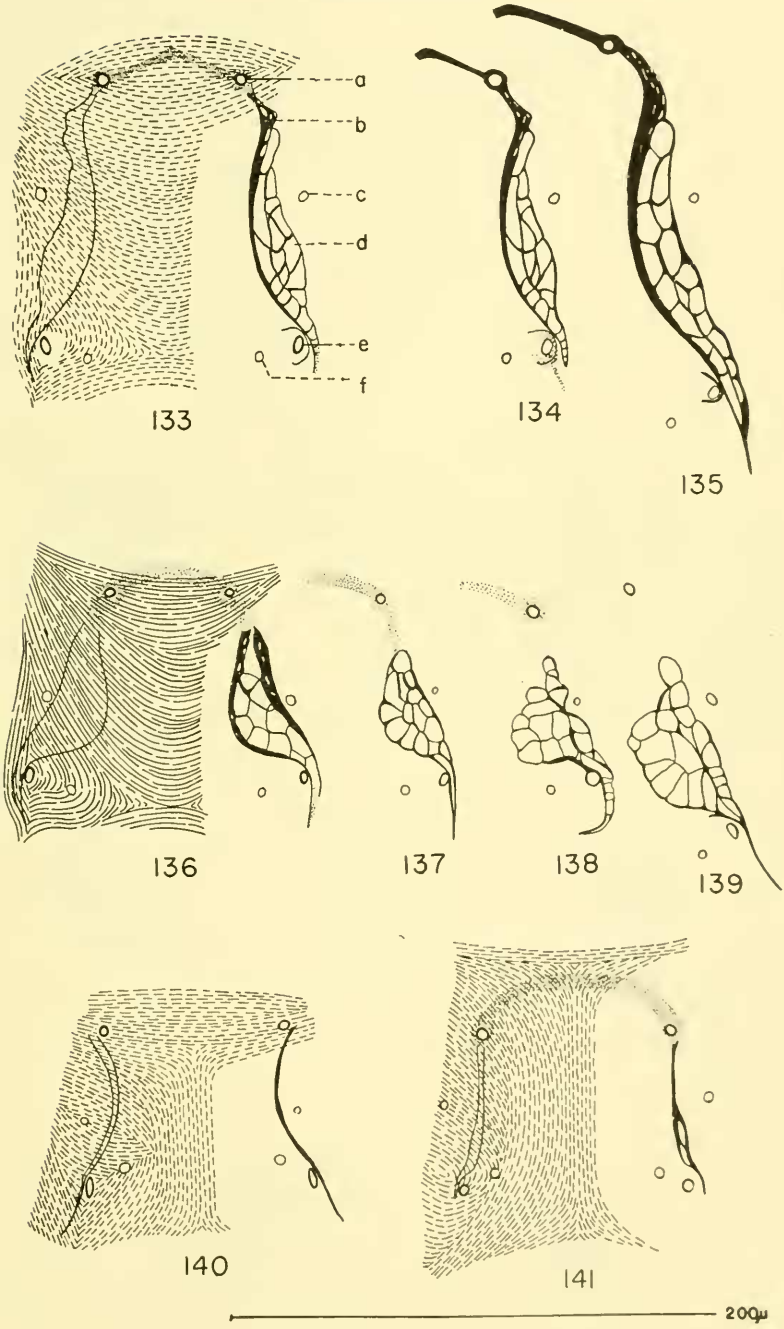
FIGURES 133-141

Striation patterns on the dorsum of the propodosoma

Fig. 133. *Bdella longicornis* from Cortez Pass, Mexico
- a. anterior pseudostigmatic organ
- b. lateral internal apodeme
- c. insertion of the lateral propodosomal seta
- d. minor internal apodemes
- e. posterior pseudostigmatic organ
- f. insertion of the median propodosomal seta

Fig. 134. *Bdella longicornis* from Cortez Pass, Mexico
Fig. 135. *Bdella longicornis* from Cortez Pass, Mexico
Fig. 136. *Bdella muscorum* from Douglas Lake, Michigan
Fig. 137. *Bdella muscorum* from N. W. Arkansas
Fig. 138. *Bdella muscorum* from Douglas Lake, Michigan
Fig. 139. *Bdella muscorum* from Iceland
Fig. 140. *Bdella tropica,* holotype
Fig. 141. *Bdella distincta,* lectotype

Figures 133-141

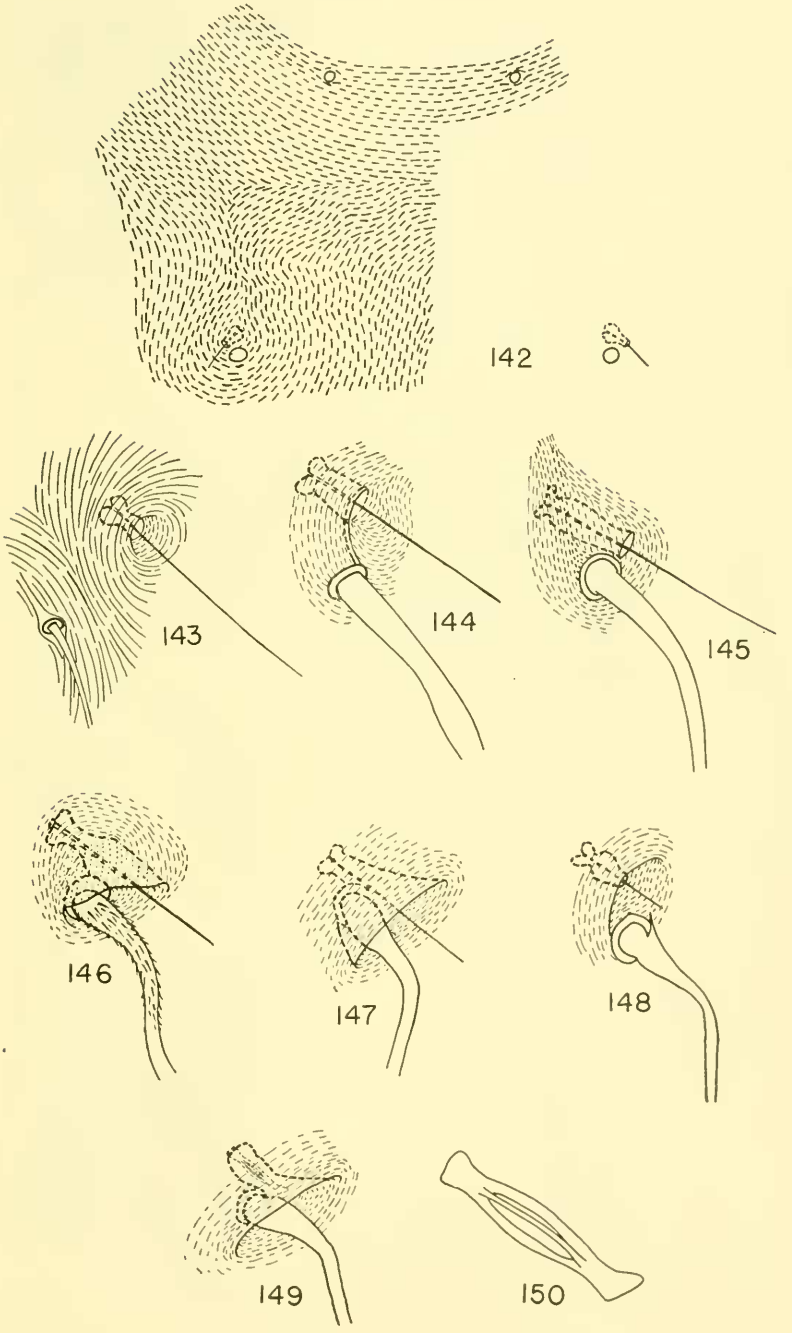


FIGURES 142-150

Modifications of the posterior sensilla and median propodosomal setae of *Thoribdella* species

Fig. 142. General striation pattern of *Thoribdella* species
Fig. 143. *Thoribdella spinosa,* holotype
Fig. 144. *Thoribdella californica*
Fig. 145. *Thoribdella meridionalis*
Fig. 146. *Thoribdella communis,* holotype
Fig. 147. *Thoribdella simplex,* holotype
Fig. 148. *Thoribdella insolita,* holotype
Fig. 149. *Thoribdella truncata,* holotype
Fig. 150. *Thoribdella truncata,* enlargement of posterior sensillum

Figures 142-150

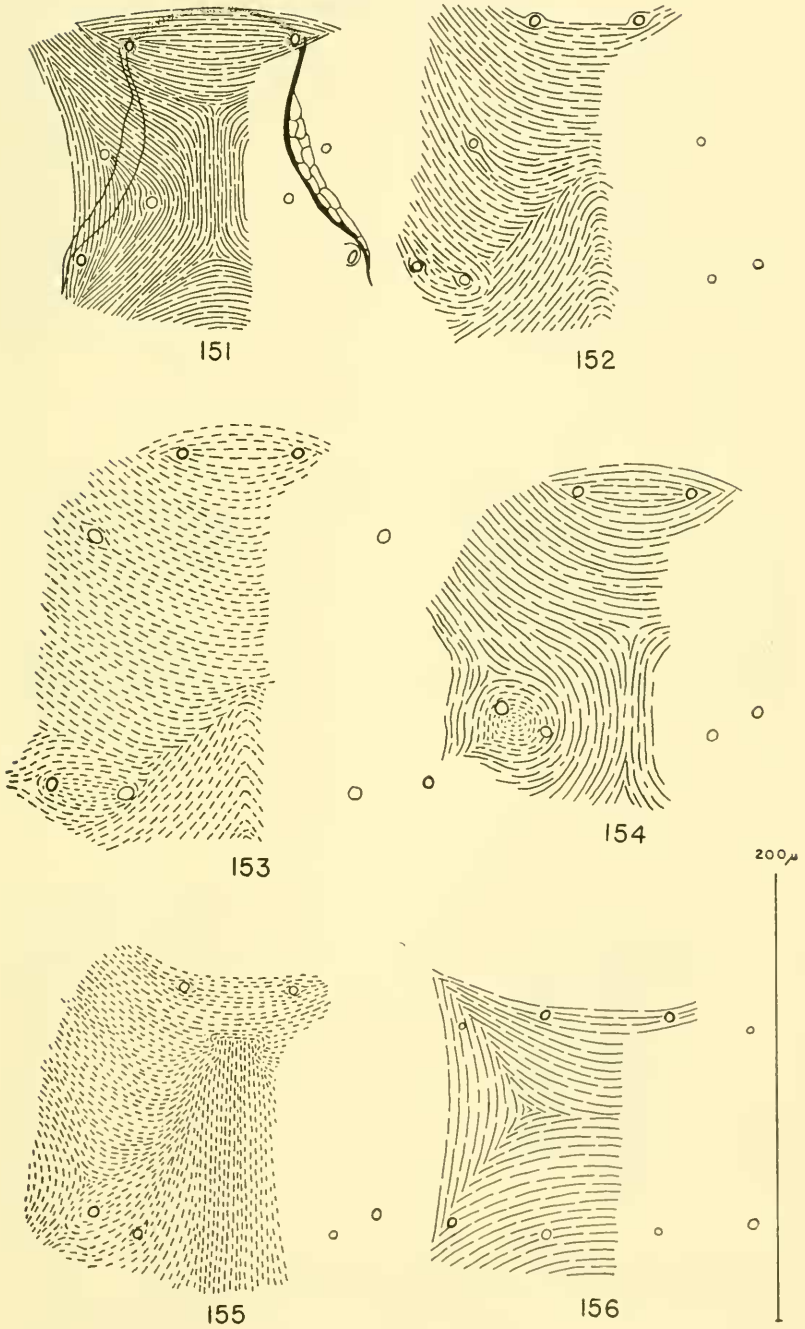


FIGURES 151-156

Striation patterns on the dorsum of the propodosoma

Fig. 151. *Bdella longistriata,* holotype
Fig. 152. *Octobdellodes hurdi,* holotype
Fig. 153. *Octobdellodes infrequens,* holotype
Fig. 154. *Odontoscirus iota,* holotype
Fig. 155. *Bdellodes bisetosa,* holotype
Fig. 156. *Spinibdella corticis*

Figures 151-156

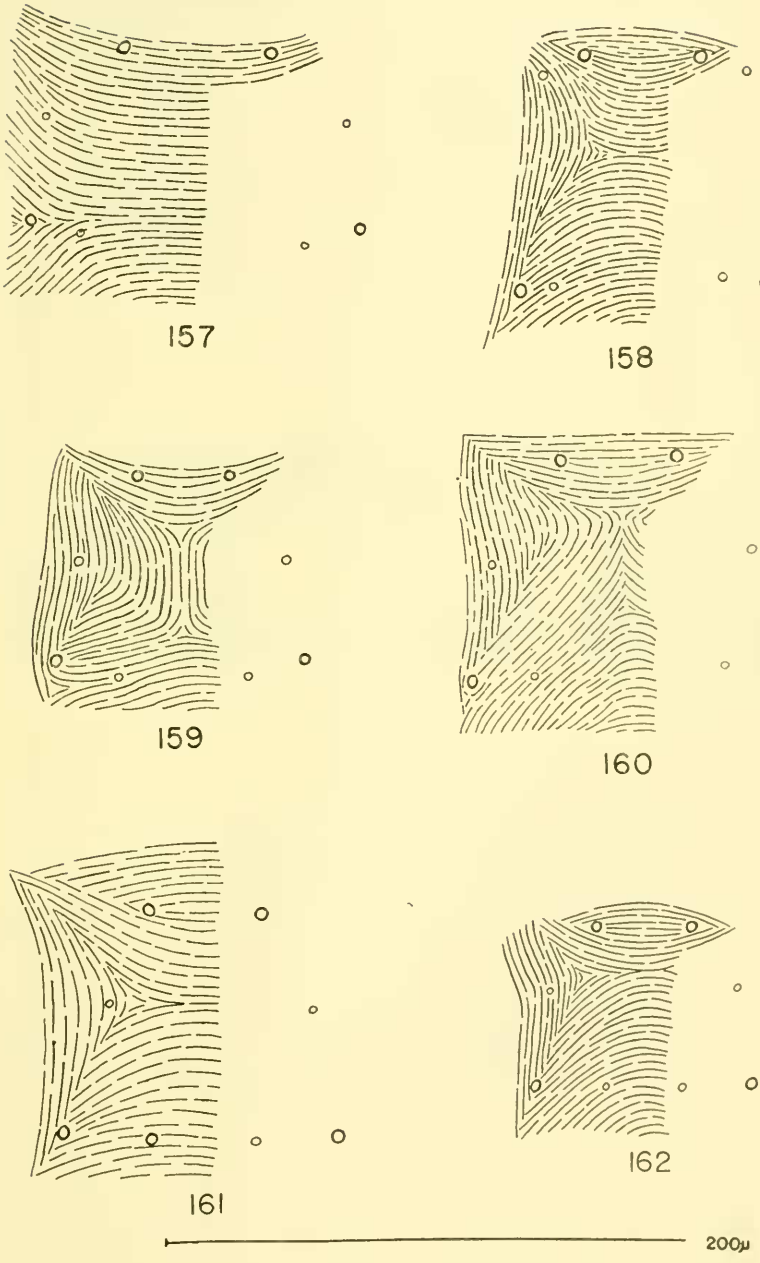


FIGURES 157-162

Striation patterns on the dorsum of the propodosoma

Fig. 157. *Spinibdella tenuirostris,* type
Fig. 158. *Spinibdella depressa*
Fig. 159. *Spinibdella cronini* from Mexico
Fig. 160. *Spinibdella cronini* from Utah
Fig. 161. *Spinibdella ornata,* holotype
Fig. 162. *Spinibdella bifurcata,* holotype

Figures 157-162



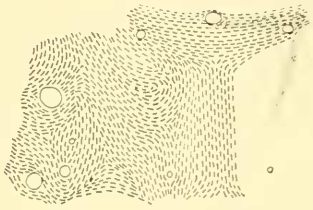
FIGURES 163-168

Striation patterns on the dorsum of the propodosoma

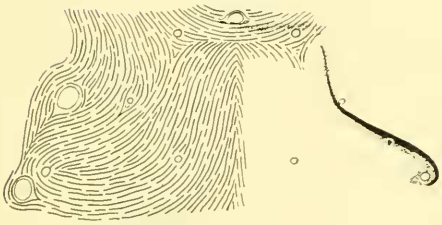
Fig. 163. *Neomolgus mutabilis,* holotype
Fig. 164. *Cyta latirostris*
Fig. 165. *Cyta coerulipes*
Fig. 166. *Biscirus silvaticus*
Fig. 167. *Cyta spuria,* holotype
Fig. 168. *Monotrichobdella maxosburni,* type (tritonymph)

Figures 163-168

163



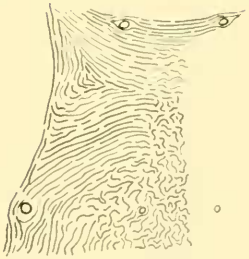
164



165

166

167



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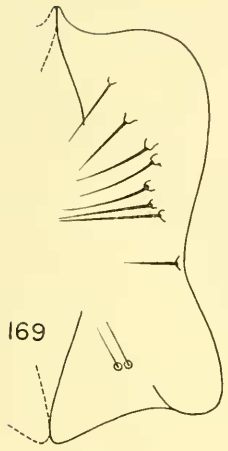
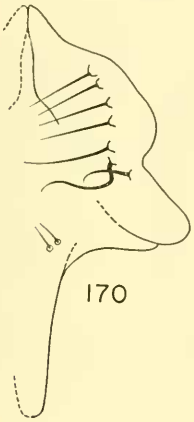
FIGURES 169-177

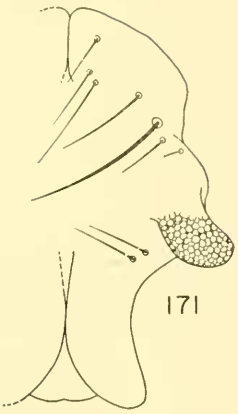
Dorsal aspects of the right amphioid sclerites

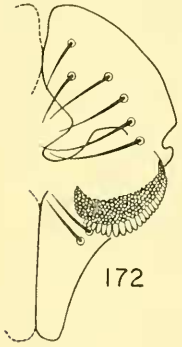
Fig. 169. *Bdella longicornis*
Fig. 170. *Bdella longistriata,* holotype
Fig. 171. *Cyta coerulipes*
Fig. 172. *Cyta latirostris*
Fig. 173. *Cyta spuria,* holotype
Fig. 174. *Spinibdella bifurcata,* holotype
Fig. 175. *Spinibdella depressa*
Fig. 176. *Spinibdella ornata,* holotype
Fig. 177. *Biscirus silvaticus*

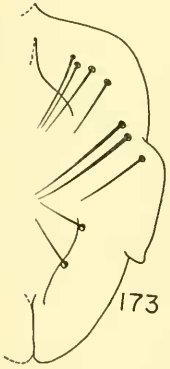
Figures 169-177

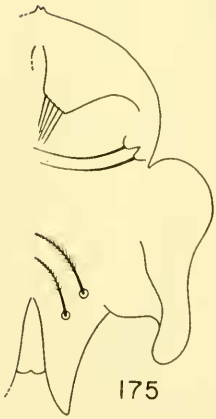












FIGURES 178-197

Fig. 178. Genital region of *Cyta latirostris*
- a. genital seta
- b. paragenital seta
- c. unpaired median paragenital seta
- d. genital trachea
- e. genital disc
- f. genital spine

Types of setae found in the Bdellidae

Fig. 179. Tactile seta, solid, pilose
Fig. 180. Tactile seta, solid, coarsely pilose
Fig. 181. Tactile seta, solid, branched
Fig. 182. Tactile seta, solid, branched distally
Fig. 183. Tactile seta, solid, plumose
Fig. 184. Trichoboth (long sensory seta of the legs)
Fig. 185. Dorsoterminal seta of legs, hollow, nude
Fig. 186. Dorsoterminal seta of legs, hollow, minutely pilose
Fig. 187. Dorsoterminal seta of legs, hollow, pilose
Fig. 188. (Chemo)sensory seta, blunt
Fig. 189. (Chemo)sensory seta, attenuate
Figs. 190-193. Modifications of peglike setae
Fig. 194. Duplex seta, insertions contiguous
Fig. 195. Duplex seta, insertions approximate
Fig. 196. Duplex seta, insertions separate
Fig. 197. Duplex seta with microseta modified as a hollow peg

Figures 178-197